The integration of dual-systems processing and cognitive bias in cognitive vulnerability to anxiety: Investigations of spider fear

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ABSTRACT

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A recent model of cognitive vulnerability to anxiety proposes that discrepant findings related to the time-course of attentional responding to threat in anxious samples may be explained by individual differences in associative and rule-based processing. Specifically, stronger fear-relevant associations and maladaptive rule-based processing are hypothesized to contribute jointly to impaired disengagement from threat. The current program of research was designed as a test of this model within the context of spider fear/phobia. In Study 1, unselected participants completed measures of spider-fear associations (Go/No-go Association Task; GNAT), attention bias (Visual Search Task; VST), and self-reported spider fear and avoidance (Fear of Spiders Questionnaire; FSQ; & Spider Phobia Questionnaire; SPQ). Results demonstrated that participants were slower on disengagement trials of the VST compared to engagement trials. Surprisingly, higher levels of spider fear/avoidance were related to faster engagement with and disengagement from threat; stronger spider-fear associations were related to reduced disengagement accuracy. Moreover, an indirect relationship between spider-fear associations and reported spider fear/avoidance via disengagement accuracy was observed, such that stronger spider-fear associations predicted reduced disengagement accuracy, which subsequently predicted higher scores on the FSQ and SPQ. In Study 2, participants were randomly assigned into 1 of 2 conditions, wherein they either repeatedly negated the threat value of spiders or repeatedly reappraised spider stimuli as

safe. As in Study 1, they completed the VST, FSQ, and SPQ. Again, all participants were slower on disengagement trials of the VST than on engagement trials. Attentional responding was unrelated to condition or to reported spider fear/avoidance. Moreover, there was no effect of condition on FSQ/SPQ scores. Exploratory analyses conducted within a restricted subsample of participants who obtained reasonable accuracy rates on the VST demonstrated that assignment to the negate condition predicted increased reported spider fear/avoidance. This relationship, however, was not mediated by attentional bias, contrary to hypotheses. For both studies, methodological limitations were noted, particularly with respect to the use of the VST. The utility of assessing fear with both indirect and direct measures is discussed, as well as theoretical and clinical implications for cognitive models of anxiety disorders and their associated treatments.

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This thesis is dedicated in loving memory to my grandmother, Helen Pardo McGuigan, who always put extra butter on my toast.

CONTRIBUTION OF AUTHORS

The following thesis comprises two manuscripts:

Study 1 (Chapter 2)

Ouimet, A. J., Radomsky, A. S., & Barber, K. C. (2012). Interrelationships between spider fear associations, attentional disengagement and self-reported fear: A preliminary test of a dual-systems model. *Cognition & Emotion*, *26*(8), 1–17. doi:10.1080/02699931.2012.671175

Study 2 (Chapter 4)

Ouimet, A. J., & Radomsky, A. S. (2013). *The effects of repeated negation and repeated reappraisal on threat-related attention and spider fear.* Manuscript in preparation for publication.

I was responsible for choosing the overall focus of this program of research as well as the selected topics for each study. I designed the methodology in consultation with Dr. Adam Radomsky. I was principally responsible for all aspects of research implementation, including study design, computer programming, participant recruitment and scheduling (via the Psychology Participant Pool at Concordia University), data collection, statistical analyses, interpretation of findings, manuscript preparation, and training of students and volunteers who were involved in this work (see below). Throughout all stages of this research project, Dr. Radomsky provided ongoing supervision, consultation, and feedback. My disseration committee members, Drs. Michel Dugas and Karen Li, provided feedback and approval of the research methods during a proposal meeting.

For Study 1, I was assisted by an honours thesis student (Kevin Barber) in several stages of the research project. He participated in stimulus selection, computer programming, data collection, and data analysis (for a different question than addressed in this thesis) as part of his honours thesis project. My role was to provide training and supervision for all of these tasks, as well as to collect much of the data myself.

For Study 2, I was assisted by undergraduate volunteers (Janice LaGiorgia and Lisa Serravalle) as well as research assistants (Stefanie Lavoie, Kevin Barber, Jeff Renaud) in the Anxiety and Obsessive Compulsive Disorders Laboratory, who contributed extensively to data collection.

For both studies, I wrote complete drafts of the manuscripts, which were reviewed by Dr. Radomsky and subsequently revised by me in response to his feedback. Both manuscripts have received blind peer reviews following submission to journals, and feedback from reviewers have been incorporated into the versions included in this thesis. The entire thesis has been written in the first person, except for the manuscript for Study 1, which has been written in the third person, as it appears exactly as published in the journal *Cognition & Emotion.*

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CHAPTER 1:

GENERAL INTRODUCTION

Fear and anxiety are normal and adaptive reactions to potentially threatening stimuli. Identification and appraisal of threats to survival are vital to the activation of safety-oriented processes, whether they are cognitive, affective, physiological and/or behavioural (e.g., LeDoux, 1996). The importance of fear-based emotions in daily life is highlighted when imagining encountering a bear in the woods, realizing that an exam for which one has not studied takes place the following day, or swerving a car to avoid hitting a large pothole. Pathological anxiety, however, occurs when these resources are activated in situations where threats to survival are minimal, or when the safety-based reaction is exaggerated (e.g., Barlow, 2002). Clark and Beck (2010) contend that clinical anxiety disorders can be differentiated from non-clinical anxiety states by five characteristics:

(1) Dysfunctional cognition, wherein the *perception* of threat is not confirmed by objective observation of the situations;

(2) Impaired functioning, both in terms of reaction to coping with a perceived threat (i.e., freezing, paralysis, or counterproductive response), and more pervasive impairments in occupational, social, routine, and relational functioning;

(3) Persistence, in that anxiety occurs not only upon exposure to a perceived threat but arises in anticipation of a *possible* feared event and endures even when the danger has passed;

(4) False alarms, wherein intense fear reactions occur in the absence (or minimal occurrence) or threat; and

(5) Stimulus hypersensitivity, which refers to the generalizability of fear to stimuli that may be only tangentially related to the original feared stimulus. For example, fear of dogs may develop, over time, from the avoidance of unleashed dogs to the complete alteration of transit routes to avoid walking through any park or green space where dogs may have been at one time (pp. 6-7).

Although the anxiety disorders share similar underpinnings in terms of both vulnerability and general framework (i.e., pathological fear), they are often differentiated by the specific content of their fears, accompanying symptoms, and idiosyncratic cognitive conceptualizations (e.g., Clark & Beck, 2010; Mineka, Watson, & L. A. Clark, 1998; Zinbarg & Barlow, 1996). Indeed, these models are often quite complex, because they represent an attempt to parsimoniously explain the contribution(s) of a multitude of factors to the aetiology and maintenance of anxiety disorders across the general population. Whereas models of specific phobia vary in their focus on evolutionary, conditioning, developmental, and cognitive factors (see Coelho & Purkis, 2009, for a review), specific phobia offers a simple yet elegant framework through which the characteristics of pathological anxiety can be understood and tested.

Specific Phobia

Specific Phobia is described as an intense fear of a specific object or situation, which causes persistent avoidance as well as significant impairment or distress (APA, 2000). Phobias typically fall into one of a few general categories: animal (e.g., spider, snake), natural environment (e.g., heights, water), situational (e.g., enclosed places), and blood-injection-injury (Antony & Barlow, 2002). Other common phobias include intense fear of clowns, choking, vomiting, space, loud sounds, and certain flowers or plants.

Current cognitive-behavioural models posit learned cue-consequence expectations as integral to the development of specific phobia. In other words, the appraisal of a certain stimulus (i.e., stimulus hypersensitivity) as safe or dangerous (i.e., false alarms) in response to biological or environmental influences, the attribution(s) (i.e., dysfunctional cognitions) made regarding bodily sensations, the perceived control over both the situation and the bodily reaction, and the behavioural strategies (i.e., impaired functioning) used to reduce anxiety all play a role in the development and maintenance of persistent (i.e., persistence) phobia (e.g, Arntz, Rauner, & van den Hout, 1995). Indeed, the way in which internal and external stimuli, safety resources, coping abilities, and consequences of one's actions are processed, determine the extent to which an individual will exhibit pathological fear and anxiety.

Information Processing in Anxiety

As originally outlined by Beck (1967), the core tenet of cognitive theory is that individuals process information in a manner that is consistent with their views of themselves, the world, and the future. This contention is well-represented in contemporary models of anxiety disorders which position information processing, whether in terms of specific biases in perception, attention, interpretation, and memory, or considered more broadly as "core beliefs", as critical, and indeed primary, in our understanding of the aetiology, maintenance, and treatment of clinical (and non-clinical) anxiety (c.f., Clark & Beck, 2010). Specifically, anxious individuals have been shown to process threat-relevant material in a biased manner via exaggerated perception (e.g., Vasey et al., 2012), preferential attention (e.g., MacLeod, Mathews, & Tata, 1986), negative interpretation (e.g., Amir, Beard, & Bower, 2005), and enhanced recall (e.g.,

Radomsky & Rachman, 1999). Moreover, the interaction among these processes has been highlighted as particularly important (Ouimet, Gawronski, & Dozois, 2009). Specifically, attention to threatening stimuli is hypothesized to influence the appraisal of said stimuli by activating relevant associations in memory, which are likely linked in a biased manner. Moreover, threatening appraisals of stimuli are posited to enhance vigilance to said stimuli, and strengthen biased memorial links. Because detection of a given stimulus is necessary to "kick-start" the cycle (White, Suway, Pine, Bar-Haim, & Fox, 2011), understanding the underlying mechanisms of threat-relevant attention may be particularly important in the investigation of information processing in anxiety.

Attention Bias in Anxiety Disorders

Although research has consistently reported evidence in support of a threat-relevant attentional bias among anxious samples (recent meta-analytic effect size: d = .45) (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007), inconsistent findings have been observed with respect to the time-course of responding to threatening stimuli (Cisler, Bacon, & Williams, 2009; Ouimet et al., 2009). Indeed, models focusing on biases at the stages of orientation, when an individual's attention is first drawn to a stimulus (e.g., <30 ms), engagement, when an individual continues to attend to a stimulus (e.g., 30-500 ms), disengagement, when an individual shifts attention away from a stimulus (e.g., 500-1000 ms), and avoidance, when an individual continues to attend away from a stimulus (e.g., >500 ms) have each received consistent empirical support (e.g., Koster, Crombez, Verschuere, Vanvolsem, & De Houwer, 2007; Mogg & Bradley, 2002; Salemink, van den Hout, & Kindt, 2007; van den Hout, Tenney, Huygens, & Merckelbach, 1995). However, a substantial minority of research findings have also

failed to find biases at each stage of processing (e.g., Fox, Russo, Bowles, & Dutton, 2001, studies 1 & 2; Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006). Moreover, the theoretical and mechanistic underpinnings of each model are somewhat in conflict. For example, whereas Fox et al. (2001) contend that observed attentional biases among anxious samples are driven by impaired (or slowed) disengagement from threatening stimuli, Koster et al. (2007) posit that anxious individuals show an initial orientation bias towards threat, but subsequently demonstrate avoidance of the same material (i.e., vigilance-avoidance models). Because the nature of attention bias varies across anxiety disorders [e.g., attention to internal representation of the self in social anxiety disorder (e.g., Schultz & Heimberg, 2008) vs. attention to physiological sensations in panic disorder (e.g., Ehlers & Breuer, 1995) vs. attention to external danger cues in specific phobia (Cisler, Ries, & Widner, 2007)], the stages of attention may be best illustrated by examining findings within a particular disorder. For the purposes of this dissertation, spider fear has been chosen as a model for more complex anxiety disorders because the feared stimulus is specific and circumscribed, allowing for a finer-grained examination of related biases.

Attention bias in spider fear/phobia. Threat-relevant attention biases have often been measured using the emotional-Stroop (e-Stroop; Gotlib & McCann, 1984), dot probe (MacLeod et al., 1986), and visual search paradigms. The e-Stroop consists of a series of threatening and neutral word-stimuli printed in coloured ink. Participants are asked to name the colour of the word while ignoring its valence. Longer word-naming latencies are inferred as indications of increased attention to, distraction by, and/or interference of the meaning of the word. Research has demonstrated that individuals with

spider fear are slower to name the colours of spider-related words and/or pictures compared to neutral, positive, and/or generally threatening (i.e., fear-relevant, but not feared, *per se*) stimuli (Chen, Lewin, & Craske, 1996; Lavy & van den Hout, 1993; Lavy, van den Hout, & Arntz, 1993; van den Hout, Tenney, Huygens, & de Jong, 1997). Additionally, spider fearful groups have exhibited significantly greater interference for spider-related stimuli than have non-anxious groups and/or groups with other anxiety disorders/concerns (Kindt & Brosschot, 1997; Lavy et al., 1993; Martin, Horder, & Jones, 1992; Olatunji, Sawchuk, Lee, Lohr, & Tolin, 2008, when participants were primed with exposure to a dead spider; Thorpe & Salkovskis, 1997; Watts, McKenna, Sharrock, & Trezise, 1986). Some studies have also demonstrated a reduction in e-Stroop interference following behavioural treatment (Côté & Bouchard, 2005; Lavy et al., 1993; Lavy & van den Hout, 1993; Thorpe & Salkovskis, 1997b; van den Hout et al., 1997; Watts et al., 1986). In contrast to consistent support for a spider-relevant cognitive bias, some research has failed to demonstrate significantly greater interference scores for individuals with spider fear compared to control participants (Kindt & Brosschot, 1998; Kolassa, Musial, Mohr, Trippe, & Miltner, 2005; Kolassa, Musial, S. Kolassa, & Miltner, 2006; Olatunji et al., 2008, when participants were not primed with exposure to a dead spider).

Originally developed by Posner, Snyder, and Davidson (1980), the dot-probe paradigm was adapted for use in psychopathological research by MacLeod et al. (1986). For the dot-probe task, pairs of stimuli differing in valence (typically threatening and neutral) are presented on the computer screen for brief periods of time. Subsequently, a small probe replaces either the negative (i.e., congruent trials) or neutral (i.e., incongruent trials) stimulus, and participants are asked to indicate with a button press either the

presence, location, or nature of the probe. Threat-relevant attention bias is inferred from slower responses on incongruent trials in combination with faster responses on congruent trials. Results from experiments using the dot-probe paradigm are consistent with those documented in the e-Stroop literature: individuals with high levels of spider fear preferentially attend to spider stimuli compared to neutral stimuli (Lipp & Derakshan, 2005; Mogg & Bradley, 2006; Vrijsen, Fleurkens, Nieuwboer, & Rinck, 2009). Moreover, although attention biases for phylogenetically prepared fear-relevant stimuli such as spiders, snakes, and angry faces are typical of unselected populations (see Ohman & Mineka, 2001, for a review), biases for spider stimuli tend to be more pronounced in spider fearful samples (Lipp & Derakshan, 2005; Mogg & Bradley, 2006; Osinsky et al., 2008). Some research, however, has failed to find such an effect (Wenzel & Holt, 1999).

Although research has generally demonstrated a spider-related attention bias in individuals with spider fear (e.g., Bar-Haim et al., 2007), there has been some argument about *when* these attention biases occur, and which stage of information processing is most important in the conferral of cognitive vulnerability to phobia. For example, two separate studies that used both masked and unmasked stimuli within an e-Stroop paradigm found evidence for biases in engagement (Thorpe & Salkovskis, 1997a; van den Hout et al., 1997), but only one demonstrated preferential processing of spider stimuli at initial orientation (Van den Hout et al., 1997). Additionally, results presented by Osinsky et al. (2008) suggest that spider-related attentional biases may include elements of both engagement (at presentation durations of 1250 ms) and avoidance (at presentation durations of 2000 ms). Research by Mogg and Bradley (2006) demonstrated initial orientation biases (200 ms presentation durations) among high, but not low spider-

fearful participants, but found no evidence of similar biases at presentation durations of 500 and 2000 ms.

As such, research remains equivocal over whether threat-relevant attention biases occur as a result of "automatic" orientation, enhanced engagement, impaired disengagement, intentional avoidance, or some combination of these processes. It appears, therefore, that although the extant literature largely supports the theory that all individuals show a tendency to preferentially process phylogenetically prepared stimuli with an enhanced effect seen in fearful participants, the evidence varies with respect to what mechanism underlies such a bias (see Cisler & Koster, 2010). According to Ouimet et al., (2009), this variability may be attributable to individual differences in associative and rule-based processing.

Dual-Systems Models in Social and Cognitive Psychology

In recent years, several dual-systems models have been advanced within the cognitive and social psychology literature (Carlston, 2010; Forgas, 2000; Lieberman, 2003; Sloman, 1996; Smith & DeCoster, 1999; Strack & Deutsch, 2004). These models share their focus on two separate, but interactive cognitive systems – often referred to as associative and rule-based – that operate jointly to problem-solve, make decisions, make social judgments, regulate emotions, and influence attitudes. In other words, these systems are posited as mechanisms underlying a wide variety of cognitive, emotional, and behavioural processes.

Although several different dual-systems models have been presented to account for various social and cognitive phenomena, they tend to share certain basic tenets. For example, whereas Sloman (1996) argued for two distinct systems of reasoning, Smith and

DeCoster (2000) focused on two systems directing encoding of information and memory retrieval. Both accounts of human cognition rest on similar assumptions. Specifically, associative and rule-based systems are distinguished by their principles of operation, rather than by their characteristics. The associative system operates by rapid activation of concepts associated in memory (e.g., links between "women" and "weak"); whereas the rule-based system evaluates the subjective truth-value or accuracy of such an association via syllogistic inferences (Gawronski & Bodenhausen, 2006; Strack & Deutsch, 2004) . This differentiation forms the foundation of dual-systems models of emotion regulation (Forgas, Ciarrochi, & Moylan, 2000; Forgas, 2000), memory in posttraumatic stress disorder (Brewin, Dalgleish, & Joseph, 1996), decision-making (e.g., Seymour Epstein, 1990; Fazio, 1990; Kirkpatrick & Epstein, 1992), social behaviour (Strack & Deutsch, 2004), cognitive vulnerability to depression (Beevers, 2005), attitude change (Gawronski & Bodenhausen, 2006), the development of addictive behaviours (Wiers et al., 2007), and most recently, cognitive bias in anxiety disorders (Ouimet et al., 2009).

Associative System

Information processing within the associative system occurs via the relatively quick activation of networks of associated representations. According to Sloman (1996), the associative system organizes mental representations to the extent that they are similar and temporally contiguous. These associations result in predictions and inferences without regard for their underlying causes or mechanisms. In other words, the associative system operates like a statistician, providing a quick response based on readily available data. The subjective truth or accuracy of the data, however, is not analyzed via the associative system (Strack & Deutsch, 2004). A simple example involves the activation

of stereotypes associated with gender, race, age, or other obvious physical characteristics. When one sees a woman, traits such as warmth, caring, sensitivity, and timidity may come immediately to mind without an explicit appraisal of this *particular* woman's personality. Furthermore, the associative system is described as a pattern-completion mechanism, wherein perceptual cues (e.g., long hair, high-pitched voice) retrieve associated representations from memory based on similarity and temporal contiguity to complete a pattern (e.g., woman), thereby activating other associated concepts such as high-strung, without examining the veracity of such an association (e.g., Smith & DeCoster, 1999).

According to Smith and DeCoster (1999, 2000), associative *learning* is also distinct from rule-based learning. They contend that representations in the associative system are learned slowly through repeated events that link two representations together. This can occur both because of similarity and temporal contiguity, as well as through repeated use of rules. For example, when first learning mathematics, we may use rules (e.g., counting fingers) to find the sum of two and two. Over time, however, the calculation "2+2" becomes associated with the response "4", and the process moves from rule-based to associative.

Simple and complex behaviour are also differentially directed by the associative and rule-based systems (Deutsch & Strack, 2006; Strack & Deutsch, 2004). Behavioural schemata are believed to be the driving force behind behaviours directed by the associative system. These schemata develop over time because of similarity and temporal contiguity between situations, stimuli, emotions, consequences, and motor

representations. Schemata are activated through spreading activation, which may occur due to perceptual input, internal drive states, or rule-based processes.

Rule-Based System

Rather than simply making a prediction based on available data, as in the associative system, processing within the rule-based system is believed to be productive, in that it can always generate new responses by combining extant rules (Sloman, 1996). Whereas mental representations in the associative system are linked due to their similarity and temporal contiguity, relationships within the rule-based system are conceptualized as connections among semantic terms with associated truth values (Strack & Deutsch, 2004). Although these representations are likely retrieved from the associative system, their examination through rule-based processes (i.e., syllogistic inferences) enables their connections within the latter system to be plastic in comparison to their less flexible links within the associative system. Furthermore, the rule-based decision-making process functions by weighing the value (i.e., true or false) and probability of potential outcomes (Strack & Deutsch, 2004).

This system is proposed to operate more slowly than does the associative system, and may be understood best as a "problem-solving" structure. For example, the computation "(376 x 523) / $\sqrt{9214}$" is unlikely to be associated in one's mind with the response "36092.0381" (although this association may be possible with repeated exposure to this problem and its solution). Rather, one will likely have to employ complex rules to solve the equation.

Behaviour derived through rule-based processing is conceptualized as the result of a decision process, rather than a simple association between an event and a behavioural

schema (Strack & Deutsch, 2004). This system "chooses" behaviour by integrating information related to the value and probability of its consequences. Habitual responses generated by the associative system can be overcome through rational decision-making regulated by the rule-based system (Lieberman, 2003). Importantly, however, adequate motivation and cognitive capacity are necessary for rule-based processing to take place and guide behaviour.

Interaction Between the Two Systems

With a few exceptions, the various models appear to concur that these two systems of processing operate simultaneously, though the associative system is believed to act more quickly (e.g., Sloman, 1996). However, associative processing is not likely terminated prior to onset (or completion) of rule-based processing. Rather, rule-based processing is posited to continually make use of associative activation, thereby resulting in continuous activation of both systems until the matter at hand is resolved (S. Chen & Chaiken, 1999). For example, in the case of a semi-skilled typist, associative processing may dictate motor movements for words consisting of letters only; however, when a sentence requires less commonly used symbols such as "$" and "*", rule-based processing may be necessary to complete the sentence. When the systems come up with competing responses, external factors such as motivation, arousal, and cognitive capacity may dictate which system "wins the race" (e.g., Smith & DeCoster, 1999).

When behavioural schemata and emotions activated via the associative system are incompatible with knowledge and intentions of the rule-based system, self-regulatory conflicts may occur (Deutsch & Strack, 2006; Metcalfe & Mischel, 1999). Because the rule-based system typically activates behavioural schemata stored in the associative

system following a decision, self-regulatory conflicts are believed to result in the activation of two (or more) incompatible behavioural schemata. Importantly, this dual activation may clarify inconsistencies in the anxiety literature with respect to the various stages of cognitive processing. Vigilance-avoidance models (e.g., Koster et al., 2006), for example, may reflect relatively "automatic" orienting and engaging with threatening material dictated by the quicker associative system, counteracted by a slower decision by the rule-based system to avoid threatening material with the goal of reducing negative affective states. As such, concepts arising from dual-systems accounts of social and cognitive phenomena may help to explain and resolve some of the inconsistencies observed in the literature pertaining to the role of information processing biases in the aetiology and maintenance of anxiety disorders.

A Multi-Process Model of Cognitive Vulnerability to Anxiety

According to Ouimet et al.'s (2009) multi-process model of cognitive vulnerability to anxiety, cognitive biases at each stage of processing (i.e., orientation, engagement, disengagement, avoidance, interpretation) are at least partially dictated by individual differences in processing by the associative and rule-based systems. Moreover, these biases are implicated in the aetiology and maintenance of anxiety disorders. Specifically, exposure to a threat-relevant stimulus (e.g., spider) is theorized to activate both systems simultaneously. Strong stimulus-fear links within the associative system are proposed to enhance both rapid orientation to and continued engagement with the stimulus. Continued engagement (and therefore, continued activation of fear-relevant links within the associative system), in turn, is posited to influence appraisal of the stimulus by the rule-based system. As such, although interpretation is often considered a

rule-based or "controlled/strategic" process (Eysenck, Mogg, May, Richards, & Mathews, 1991; Teachman, 2005), Ouimet et al. (2009) contend that interpretation is influenced (i.e., biased) by information activated via the associative system. Indeed, a wealth of evidence supports the existence of rapid biased threat appraisal occurring earlier (i.e., "automatically") than would be expected for a purely rule-based process (Clark & Beck, 2010, pp. 69-72). This interaction between associative and rule-based systems represents a positive feedback loop, wherein increased activation within the associative system is proposed to lead to enhanced engagement with fear-relevant stimuli, which in turn may result in persistent activation of stimulus-fear associations, biased appraisal, and continued attention (i.e., impaired disengagement).

Under ideal conditions of motivation, working memory capacity, and arousal, the rule-based system may override the "attend" feedback loop, either by deactivating the fear-relevant associations or by making a behavioural decision to actively disengage attention from the stimulus (Ouimet et al., 2009). According to Gawronski and Bodenhausen (2006), the rule-based system may attempt to accomplish this via (in)validation of activated links in one of three ways: (1) the threat value of the stimulus may be affirmed (e.g., "the spider is very dangerous and might harm me"); (2) the threat value of the stimulus may be negated (e.g., "the spider is not dangerous"); or (3) the threat value of the stimulus may be reappraised as safe (e.g., "the spider is friendly and keeps my house free of other insects"). Both affirmation and negation are hypothesized to contribute to impaired disengagement via response conflicts between the associative and rule-based systems, whereas reappraisal is expected to deactivate associative links between fear and the relevant stimulus, thereby discontinuing attention to the stimulus

and weakening links over time (Ouimet et al., 2009). Indeed, research has demonstrated that repeated negation of gender stereotypes resulted in the ironic increase of such associations (e.g., women-weak); whereas reappraisal of such stereotypes resulted in the consequent weakening of such associations (Gawronski, Deutsch, Mbirkou, Seibt, & Strack, 2008).

The main implication of this model is that processing within both the associative and rule-based systems is believed to contribute to self-regulatory conflicts, which may drive observed discrepancies across experiments examining the time-course of attentional responding to threat. Specifically, individual differences in strength of associations and use of rule-based validation processes are hypothesized to dictate the point at which individuals are able to disengage from threatening stimuli.

The current studies were designed as a preliminary test of the multi-process model of cognitive vulnerability to anxiety (Ouimet et al., 2009). Although this model applies to anxiety more broadly, it lends itself well to investigation within the framework of spider fear. Two studies using contemporary methodologies were conducted to examine the extent to which associative and rule-based systems influence impaired disengagement from spider-related stimuli, and subsequently, impact upon phobic symptoms among individuals falling within a broad range of spider fear levels. The results have potentially important implications for our understanding of the role played by cognitive bias in the conferral of vulnerability to anxiety disorders, as well as for the development of effective psychological treatments.

The first of these studies measured spider related associative fear networks using the Go/No-go Association Task (GNAT; Nosek & Banaji, 2001), and assessed its ability

to predict speed of disengagement from spider stimuli in a modified visual search paradigm and subsequent overt spider fear. The second study manipulated the way in which individuals appraised spider stimuli and assessed the effects of said manipulation on speed of attentional disengagement and subsequent spider fear.

In Study 1, it was hypothesized that spider-fear associations would demonstrate an indirect relationship with increased reported spider fear via impaired disengagement, wherein stronger spider fear associations were hypothesized to predict slower disengagement from spider stimuli, which were hypothesized to subsequently predict higher levels of self-reported spider fear. In Study 2, it was hypothesized that individuals who repeatedly negated the threat value of spiders would show greater impaired disengagement from spider-related stimuli and, consequently, more self-reported spider fear than would individuals who repeatedly reappraised spider-related stimuli as safe.

CHAPTER 2:

INTERRELATIONSHIPS BETWEEN SPIDER FEAR ASSOCIATIONS, ATTENTIONAL DISENGAGEMENT AND SELF-REPORTED FEAR: A PRELIMINARY TEST OF A DUAL-SYSTEMS MODEL

Although research has generally demonstrated a spider-related attention bias in individuals with spider fear (e.g., Bar-Haim et al., 2007), research remains equivocal over whether threat-relevant attention biases occur as a result of 'automatic' orientation, enhanced engagement, or impaired disengagement processes. Whereas orientation and engagement can be assessed separately via the use of subliminal and supraliminal stimulus presentations, respectively, disentangling enhanced engagement and impaired disengagement is more difficult using the standard e-Stroop and dot probe paradigms (e.g., Fox et al., 2001). Some recent studies, therefore, have used visual search paradigms (e.g., Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005), wherein participants are presented with stimulus matrices and are asked to determine whether there is a discrepant stimulus among homogenous stimuli. Enhanced engagement with spider stimuli for example, is inferred from response times on trials where participants must identify a spider target among non-spider related distracters, whereas impaired disengagement is assessed on trials where participants must find a non-spider related target among spider related distracters.

Several studies have demonstrated that unselected participants are quicker to find fear relevant (FR) stimuli (e.g., snakes, spiders) among matrices of fear irrelevant (FI) stimuli (e.g., flowers, cats, fish) than they are to detect the presence of a FI target among matrices of FR distractors (e.g., Flykt, 2006). This interaction may represent either

enhanced engagement with the FR stimuli (i.e., speeded detection of FR target among FI distractors), or impaired disengagement from the threat-relevant stimuli (i.e., slowed detection of FI target among FR distractors). In a modified visual search task, wherein both a target and distractor were presented within a matrix of unrelated stimuli, individuals were slower to detect the presence of either an FR or FI target if the distracter was FR (Lipp & Waters, 2007). These results provide support for the contention that delayed disengagement may drive observed threat-relevant attention biases.

Several researchers have investigated this hypothesis among spider and/or snake fearful samples using traditional visual search paradigms. The majority of these studies found not only enhanced attention biases for FR stimuli (e.g., Rinck et al., 2005), but also an effect of specific fear, such that spider-fearful participants showed enhanced detection of, and distraction by, spider stimuli compared to snake stimuli, whereas snake fearful participants evidenced the opposite pattern (e.g., Soares, Esteves, & Flykt, 2009). Furthermore, results from experiments using the modified visual search paradigm are consistent with the theory that these effects are attributable to impaired disengagement from feared stimuli among fearful individuals (e.g, Lipp & Waters, 2007).

Although the extant literature largely supports the theory that individuals show a tendency to preferentially process phylogenetically prepared stimuli with an enhanced effect seen in fearful participants, the evidence varies with respect to what mechanism underlies such a bias (Cisler & Koster, 2010; Ouimet et al., 2009). According to Ouimet et al., this variability may be attributable to individual differences in associative and rule-based processing.

Dual-Systems Understanding of Cognitive Bias in Spider Fear

Dual-systems models propose that a given stimulus activates two distinct but interacting cognitive systems simultaneously: the associative and rule-based systems (e.g., Strack & Deutsch, 2004). Spreading activation of the associative system rapidly activates concepts related to the stimulus in memory, including specific attitudes, beliefs, or behaviours. Concurrently, the rule-based system appraises the subjective truth-value of the activated links and may serve to confirm or alter the responses generated by the associative system (Gawronski & Bodenhausen, 2006). When the respective responses of each system conflict, factors such as arousal, cognitive load, and motivation may influence which system 'wins the race'. With respect to cognitive bias in the anxiety disorders, Ouimet et al. (2009) contend in their recent model of cognitive vulnerability, that it is this self-regulatory conflict which dictates at which point individuals are able to disengage from threat-relevant stimuli. Specifically, when a spider-fearful individual encounters a threat-relevant stimulus (e.g., spider picture), the rapid activation of his/her spider-related associative fear network leads to enhanced engagement with the stimulus. Concurrently, the rule-based system begins to analyze the factual relation between these concepts (e.g., "Is this spider stimulus actually dangerous? Do I actually need to escape?"). When the associative fear network remains active (e.g., because of continued engagement with the spider stimulus), it may enhance the likelihood of a threatening interpretation by the rule-based system. In contrast, if an individual successfully engages in reappraising the stimulus as safe (or relatively neutral), the response generated by the rule-based system will be to disengage from the stimulus, thereby slowing down the spreading activation of the associative system, reducing anxiety, and weakening the strength of associative links over time. If however, the individual attempts to negate the

threat value of the stimulus (e.g., the spider is not dangerous), rapid activation of threat-related associations will continue (ironically – attributable to activation of 'danger' concepts in memory), impairing disengagement from the stimulus, increasing anxiety, and reinforcing associative links over time (Ouimet et al., 2009). Although the difference between 'reappraisal' and 'negation' is subtle, research from the social-cognitive literature has supported the contention that repeated negation of stereotypic associations leads to strengthening of such associations, whereas repeated reappraisal of the same associations results in their consequent weakening (Gawronski et al., 2008). Moreover, recent research from our lab demonstrates that compared to repeated reappraisal of spider-fear associations, repeated negation results in higher levels of reported spider fear (Ouimet, Barber, & Radomsky, 2011).

Associative processing in spider fear. Several measures have been developed in recent years to assess associations in memory (e.g., Implicit Association Test [IAT]; Greenwald, McGhee, & Schwartz, 1998; Go/No-go Association Task [GNAT]; Nosek & Banaji, 2001). Research has demonstrated that spider-fearful participants show stronger spider-fear associations than do snake-fearful and non-fearful participants (Ellwart, Rinck, & Becker, 2006; Huijding & de Jong, 2005; Rinck & Becker, 2007; but see de Jong, van den Hout, Rietbroek, & Huijding, 2003). Additionally, scores on the IAT evidenced reduced strength among spider-fearful participants following Cognitive Behavioural Therapy (CBT), with changes maintained at two month follow-up (Teachman & Woody, 2003).

Research has generally supported the contention that, in comparison with non-fearful participants, spider-fearful individuals exhibit stronger spider-relevant fear

networks. Importantly, some studies have additionally shown that indirect measures (i.e., IAT) predict spider fear-related behaviour (e.g., Huijding & de Jong, 2005), physiological responses (Van Bockstaele et al., 2011a), and peak anxiety during a behavioural approach task (Teachman, 2007) independently of direct measures. It may be that results obtained from direct questionnaires related to spider fear are attributable to a combination of associative and rule-based processes (Ouimet et al., 2009). In other words, individuals may moderate their responses to questionnaires following simultaneous rule-based appraisal of stimuli associated with fearful concepts in memory.

Finally, a recent study examining the differential predictive power of indirect and direct measures of spider fear on behavioural and physiological fear responses to spiders assessed both spider-fear associative strength and attentional bias (Van Bockstaele et al., 2011a). Although direct and indirect measures of spider fear did not correlate significantly, stronger spider-fear associations were related to slower disengagement from spiders. Additionally, experimental reduction of spider-relevant attention bias did not lead to reduced spider-fear associations (Van Bockstaele et al., 2011b), providing preliminary support for the contention that such associations are not merely correlates of attention biases, but may be implicated in their development.

The present study was designed as a preliminary test of a dual-systems model of attention bias in anxiety, wherein only the relationships between associative processing, attentional engagement/disengagement, and reported spider fear were measured (Ouimet et al., 2009). As outlined in Ouimet et al.'s model, stronger fear-relevant networks are posited to lead to enhanced engagement with and impaired disengagement from fear-relevant stimuli, reflecting an attention bias which has been demonstrated to contribute at

least to the maintenance of anxious symptoms. As such, we examined whether speed of engagement and/or disengagement mediated the relationship between strength of spider-fear associations and self-reported spider fear. Participants completed a Go/No-go Association Task to assess the relative extent to which participants categorized spider pictures as "afraid" or "calm", a visual search task (VST) to examine their ability to disengage from and detect spiders and categorically distinct insects, and self-report measures of spider fear and avoidance. We hypothesized that, in line with Ouimet et al., stronger spider-fear associative links would predict impaired disengagement from spider stimuli (i.e., increased time to detect insect target among spider distracters), which would subsequently predict reported spider fear and avoidance.

Method

Participants

One hundred thirty-one participants (79.5 % female, mean age = 22.68 [5.50] years) were recruited from the undergraduate psychology participant pool at Concordia University. The majority of participants were single (92.1%) and of European descent (75.4%). They were compensated with course credit or with an entry in a draw for a cash prize.

Apparatus

All questionnaires and cognitive tasks were administered on a Dell Precision T1500 desktop computer with a 22-inch monitor (30cm x 48cm). Participants were seated approximately 65cm (~25") from the monitor and responded to stimuli using a standard keyboard.

Self-report Questionnaires

Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995). The FSQ is an 18-item questionnaire which assesses avoidance and fear of harm from spiders. Participants rated the extent to which they agreed (0 = totally disagree, 7 = totally agree) with statements such as "If I came across a spider now, I would leave the room." The FSQ demonstrates excellent internal consistency ($\alpha = .92$; Szymanski & O'Donohue, 1995), test-retest reliability ($r = .91$), and good convergent and discriminant validity (Muris & Merckelbach, 1996).

Spider Phobia Questionnaire (SPQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974). The SPQ is a 31-item measure, which asks participants to answer "true" or "false" to statements about cognitive and behavioural indices of spider fear such as "I avoid going to parks or on camping trips because there may be spiders about". The SPQ demonstrates excellent internal consistency ($.95 < \alpha < .97$), test-retest reliability ($r = .94$), and differentiates between individuals with and without spider phobia (Muris & Merckelbach, 1996).

Beck Anxiety Inventory (BAI; Beck & Steer, 1993). The BAI is a 21-item questionnaire where respondents rate the degree to which they have experienced symptoms of anxiety (e.g., hands trembling, nervous) during the past week. The BAI is a frequently used measure of anxiety with well-established psychometric properties (Beck, Epstein, Brown, & Steer, 1988).

Beck Depression Inventory-II (BDI; Beck, Steer, & Brown, 1996). The BDI consists of 21 items related to symptoms of depression (e.g., fatigue, sadness, suicide ideation, restlessness) experienced over the preceding two weeks. The BDI has well-established psychometric properties (Dozois & Covin, 2004).

Subjective Units of Distress Scale (SUDS; Wolpe, 1958). The SUDS is a measure of state distress. Respondents rate the extent to which they feel distressed on a scale from 0 (no distress) to 100 (extreme distress). These ratings have demonstrated correlations with physiological measures of stress (Thyer, Papsdorf, Davis, & Vallecorsa, 1984). For the current experiment, participants completed the original SUDS as well as 3 modified versions assessing feelings of happiness, frustration, and sleepiness.

Stimulus ratings. Participants completed a measure designed for this study assessing subjective pleasantness and fear-relevance of all presented stimulus categories. This measure consisted of 18-items, 2 per stimulus category (e.g., spider, beetle, zebra), which required participants to indicate on a 7-point Likert-type scale the extent to which they found each stimulus pleasant (0 = extremely unpleasant; 6 = extremely pleasant), how fearful they were of each stimulus (0 = no fear; 6 = terror), and how easily they were able to recognize each stimulus (0 = extremely unrecognizable; 6 = extremely recognizable).

Cognitive Tasks

Go/No-go Association Task (GNAT; Nosek & Banaji, 2001). The GNAT was used to measure spider-related associations in memory. The design of the GNAT was modeled after Teachman (2007). Participants' pressed the "Go" button (spacebar) if the presented stimuli fell into either the category presented on one side of the screen (e.g., spider) or represented the attribute presented on the other side of the screen (e.g., afraid; see Figure 1). Otherwise, they were required not to respond, but to wait for the next trial to begin. Strong spider-related associative fear networks were inferred from greater speed

Figure 1

Sample of a target-present Spider+Afraid trial on the Go/No-go Association Task

of stimulus categorization when the category "spider" was paired with the attribute "afraid", than when it was paired with the attribute "calm".

The GNAT consisted of two critical, counterbalanced blocks (60 trials each). For all trials in Block A, the word "SPIDER" appeared on the top left side of the screen, and the word "AFRAID" appeared on the top right. For Block B, the word "spider" continued to appear, but was paired with the word "calm" on the right side of the screen. The target and descriptor labels (i.e., "SPIDER", "AFRAID", and "CALM") appeared in white Arial font (all capital letters), sized to occupy 5% of the screen (1.5 cm in height). Picture stimuli appeared in the center of the screen, and measured 6.5 cm high by 6.5 cm wide; lexical stimuli were identical in form to the target and descriptor labels. Each participant began the task by completing three counterbalanced single categorization blocks, consisting of 12 trials each.

With respect to the critical paired blocks, only the target (i.e., spider pictures) and attribute-consistent descriptor trials (e.g., fear-related words when "spider" is paired with "fear") were used for analyses. As such, twice as many target and attribute-consistent descriptor trials were presented compared to filler and attribute-inconsistent descriptor trials, to increase reliability of the task (see Nosek & Banaji, 2001; Teachman, 2007). To balance time-pressure and accuracy, target and attribute-consistent filler stimuli were presented for 1400ms (or until key-press), whereas filler and attribute-inconsistent descriptor stimuli were presented for 1000ms. Stimuli appeared in a completely randomized order across trials, with no constraints applied to which type of stimulus appeared on which trial, other than the ratio constraint described above. For each block, each stimulus within a given category was presented at least once before it was repeated. Error feedback was presented for 500 ms following each incorrect key-press or omission

of key-press (red "X" in the center of the screen); correct responses were followed by a green "O" in the center of the screen. Error feedback was followed by an interstimulus interval (ISI) of 1000ms. For the current sample, internal consistency was excellent for log-transformed responses on the Spider+Afraid trials (α = .91), Spider+Calm trials (α = .89), and composite reliability (see Table 1).

Stimuli. For each trial, a single stimulus appeared in the center of the screen. Stimuli consisted of category pictures and attribute words. Twenty pictures of spiders varying in size and type functioned as target stimuli, whereas filler stimuli consisted of other animals (rabbits, snakes, bears, crocodiles, zebras), varying in threat level. Attribute words (20 per attribute category) described either feelings of calmness (e.g., relaxed, serene, cool, tranquil), or feelings related to fear (e.g., terrified, scared, timid, anxious). All stimuli were piloted for recognizability, valence, and fear-relevance[1].

Visual search task (VST). The current visual search task was modeled after the odd-one-out search task described by Rinck et al., (2005), which assesses engagement with and disengagement from spider stimuli. The first trial began with the presentation of a white fixation cross in the center of the screen for 500 ms, followed by a 4x4 matrix of 16 'bug' pictures, which remained on the screen until key press or until 6000 ms had elapsed. Participants were asked to press a "yes" button on the keyboard if a discrepant stimuli (i.e., odd-one-out) appeared among 15 categorically homogenous stimuli, or to press a "no" button on the keyboard if all the stimuli within a matrix belonged to the same bug category (i.e., spider, butterfly, beetle, or dragonfly). For all trials, incorrect responses were followed by the 250 ms presentation of a red "X" in the center of the screen and correct responses were followed by a green "O", which acted as fixation

[1] Detailed description of pilot data and analyses are available from the corresponding author.

crosses for subsequent trials. Error feedback was followed by a 500 ms interstimulus interval (ISI). One hundred thirty trials were presented to each participant: 24 engagement, 24 disengagement, 36 control, 40 target absent, and six practice trials.

For engagement trials (see Figure 2), participants were asked to indicate the presence of a spider, beetle, or butterfly among a matrix of dragonflies. Impaired disengagement trials, in contrast, consisted of a dragonfly target, but the homogenous distracters were spiders, beetles, or butterflies. For both types of matrices, eight trials of each matrix form were presented (e.g., eight spider among dragonflies matrices). Control search trials included six trials of each possible variation of targets and distracters, other than those included in the engagement and disengagement trials. Forty target-absent trials (10 for each type of stimulus) were interspersed throughout the experiment to ensure that participants maintained careful responding. Six practice trials were presented prior to the 124 experimental trials. For each trial, the placement of the target and the arrangement of the distractors were completely randomized.

Stimuli. Stimuli included 16 pictures each of spiders, butterflies, beetles, and dragonflies, which were piloted for fear-relevance, pleasantness, and recognisability. As predicted, spiders were rated as most anxiety-provoking followed by beetles, dragonflies, and butterflies. Pictures measured 5.5 cm by 5.5 cm and, on each trial, were presented on a black background in 4x4 matrices. Pictures were evenly spaced across the screen and were centred both horizontally and vertically.

Procedure

Each participant was tested individually. Before beginning the experiment,

Figure 2

Sample of an engagement trial on the Visual Search Task

participants were informed that the purpose of the study was to pilot new measures of cognitive processing. All further instructions, tasks, and questionnaires were presented via the computer using Inquisit 3.0 Desktop experimental software (2009).

Participants began the experiment by completing a demographic questionnaire and initial SUDS ratings for fear, happiness, frustration, and sleepiness. Subsequently, they completed either the GNAT or VST, the ordering of which was counterbalanced across participants. Following the completion of the first computer task, participants rested during a two-minute break in the testing room and then completed SUDS ratings for a second time. Participants then completed the second computerized task, followed by a break, and SUDS ratings. Finally, participants completed all mood questionnaires on the computer, in a completely randomized order, with the constraint that measures assessing pleasantness, recognizability, and fear-relevance of experimental stimuli were completed last.

Results

Data Preparation

GNAT. Similar to Teachman (2007), distracter trials were removed from analyses and error rates were calculated for each block. One participant was excluded for an overall accuracy rate of 63%. All reaction times shorter than 300 ms were deleted. Additionally, the data was examined to ensure that no participant responded randomly (<300ms) on more than 10% of trials. For remaining trials, overall mean accuracy rates and mean accuracy rates for each block were greater than 99%. Response times for each trial were log-transformed, and a mean score was obtained for each block. A GNAT score was computed for each participant by subtracting the mean response times for the

Spider+Afraid block from the mean response times for the Spider+Calm block, such that higher GNAT scores reflected stronger spider-fear associations. Two GNAT scores fell greater than 3 standard deviations above the mean; these participants were excluded.

VST. Data from the VST were examined for accuracy rates after the removal of target absent trials. In contrast with previous research which demonstrated reasonable error rates for this task (e.g., 2%, Rinck et al., 2005), one sixth of participants had error rates greater than 25% across all trials of the VST, and error rates were significantly different according to trial type, $F(2, 250) = 95.58$, $p < .001$. Participants were less accurate on spider-disengagement trials than on spider-engagement, $t(250) = -14.1$, $p < .001$, and non-spider trials, $t(250) = -8.73$, $p < .001$, and less accurate on engagement trials than on non-spider trials, $t(250) = 4.5$, $p < .001$. Given the unexpected differences in accuracy according to trial type, it would not be reasonable to exclude participants based on low accuracy because this appears to be an important variable related to the current hypotheses. Reaction time data was calculated only for trials on which participants correctly identified whether an odd-one-out was present in the matrix.

One participant evidenced response times greater than three standard deviations above the mean and his/her data were thus excluded from subsequent analyses. Descriptive data for the GNAT and VST for the final sample (n =126) are presented in Table 1. Consistent with previous research, participants evidenced significant differences in reaction time depending on trial type, $F(2, 124) = 8.20$, $p < .001$. Specifically, participants were slower on disengagement trials than on engagement, $t(124) = 4.04$, $p < .001$, and non-spider trials, $t(124) = 2.89$, $p < .01$; engagement and non-spider trials did not differ.

Table 1

Descriptive data (n = 126, except SUDS =125)

Variable	Mean	SD	Min.	Max.	α
GNAT-log	.054	.067	-.14	.20	.94
VST Accuracy	-	-	-	-	-
Overall	.84	.08	.62	.98	-
Spider-engagement	.90	.07	.65	1.00	-
Spider-disengagement	.75	.12	.45	1.00	-
Non-spider control	.85	.10	.55	1.00	-
VST Reaction times (ms)	-	-	-	-	-
Overall	2122.15	339.56	1337.74	2970.44	.93
Spider-engagement	2084.56	375.92	1117.31	3019.31	.77
Spider-disengagement	2193.23	438.81	794.69	3449.13	.81
Non-spider control	2106.93	351.44	1381.77	2937.11	.88

VST Indices					
Disengagement speed (ms)	86.29	335.24	-1854.38	753.82	-
Engagement speed (ms)	-22.38	278.85	-1299.07	776.58	-
Disengagement accuracy (%)	-9.59	12.65	-48.00	25.00	-
Engagement accuracy (%)	4.54	10.76	17.00	45.00	-
BAI	11.03	8.14	0.00	49.00	.89
BDI	10.08	8.01	0.00	46.00	.90
FSQ	33.74	35.67	0.00	122.00	.97
SPQ	10.87	7.55	1.00	30.00	.93
SRs	3.64	0.75	1.00	5.00	-
SUDS: Pre-test	21.57	25.77	0.00	100.00	-
SUDS: Post-GNAT	22.42	25.92	0.00	100.00	-
SUDS: Post-VST	23.54	24.99	0.00	90.00	-

GNAT-log = log-transformed Go/No-go Association Task; VST = visual search task; BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; FSQ = Fear of Spiders Questionnaire; SPQ = Spider Phobia Questionnaire; SRs = stimulus ratings; SUDS = subjective units of distress scale, anxiety item

Difference scores for both accuracy and reaction times were calculated to generate four indices: (1) Disengagement speed (Disengagement RT - Non-spider RT); positive scores reflect impaired disengagement, negative scores reflect facilitated disengagement; (2) Engagement speed (Engagement RT - Non-spider RT); positive scores reflect reduced engagement, negative scores reflect enhanced engagement; (3) Disengagement accuracy (Disengagement accuracy - Non-spider accuracy); positive scores reflect higher accuracy, negative scores reflect less accuracy; and (4) Engagement accuracy (Engagement accuracy - Non-spider accuracy); positive scores reflect higher accuracy, negative scores reflect less accuracy. One-sample t-tests demonstrated that all index means were significantly different from 0 ($p < .006$) except for engagement speed, which was not significantly different from 0.

Sample Characteristics

Preliminary analyses included an examination of participants' scores on various mood measures (see Table 1). Analyses of Variance (ANOVA) indicated that there were no significant differences on scores of variables of interest according to age, examiner, handedness, or level of education. A significant effect of sex emerged such that female participants scored higher on measures of reported spider fear (FSQ, $F[1,125] = 7.63$; SPQ, $F[1, 125] = 15.68$; SRs, $F[1, 124] = 8.39$, all ps $< .05$) and spider-fear associations (GNAT, $F[1,125] = 5.35$, $p < .05$) than did male participants. There were no significant differences in performance on the GNAT or VST depending on which task participants completed first. A block order effect did emerge, however, for the GNAT. Participants who completed the Spider+Calm block before the Spider+Afraid block showed significantly stronger spider-fear associations, $t(1) = 3.13$, $p < .01$. Most people are

quicker to categorize spiders as fear-related; this effect was enhanced by practice for participants who completed the Spider+Afraid block following the Spider+Calm block and attenuated for participants who completed the blocks in the opposite order.

Subjective Mood Data

Subjective measures of distress, happiness, frustration, and sleepiness were administered at pre-test and after each cognitive task (three time points). Four separate 2 (counterbalance order) x 3 (time point) repeated-measures ANOVAs were conducted to assess whether mood changed as a result of cognitive task order, and the extent to which this was influenced by task type. Although all four mood types changed according to similar patterns, significant findings were obtained for measures of happiness and frustration only. Specifically, regardless of condition, participants were less happy with the completion of each subsequent task (main effect of time; $F[2, 123] = 11.48$, $p < .01$). There was a trend towards an interaction between time and condition, which suggested that individuals showed the greatest decreases in happiness following completion of the VST as compared to the GNAT, $F(2, 123) = 2.63$, $p = .08$. Participants evidenced significantly greater levels of subjective frustration at time 2, $t(2) = 3.44$, $p < .05$, and time 3, $t(2) = 4.44$, $p < .05$, as compared to time 1. Moreover, an interaction between condition and time emerged such that participants indicated the greatest increases in frustration following the VST as compared to the GNAT, $F(2, 123) = 6.57$, $p < .05$.

Correlations

Generally, correlations (see Table 2) were consistent with previous research, in that measures of psychopathology were significantly correlated, with the strongest correlations emerging amongst measures assessing similar constructs (e.g., FSQ, SPQ).

Of particular interest to the current hypotheses were small, but significantly or marginally significant positive relationships between spider-fear associations and self-reported spider fear, anxiety ratings of spider stimuli, and pre-test state anxiety (SUDS measured prior to beginning first task). Additionally, stronger spider-fear associations were associated with reduced accuracy on the spider disengagement accuracy index only. Finally, higher reported levels of spider fear were related to faster response times for spider-engagement and spider disengagement trials.

Closer examination of the finding that spider fear was associated with faster response times on disengagement trials, in contrast with previous findings, indicated that greater accuracy was generally significantly associated with decreased speed. Results were consistent with a speed/accuracy trade-off. Moreover, it appears that reaction times and accuracy on the VST may be distinctly related to indirect (i.e., GNAT) and direct (i.e., self-report questionnaires) measures of spider fear. As such, the inclusion of all four indices of attention bias as possible mediators of the relationship between spider-fear associations and reported spider fear was warranted.

Mediation Analyses

Three separate multiple mediation analyses were conducted according to the Bootstrapping approach (5000 samples, 95% confidence interval, bias corrected and accelerated) using the SPSS INDIRECT macro created by Preacher and Hayes (2008)[2]. For each analysis, the independent variable was GNAT score, and the four attention indices described earlier were included as mediators: (1) Disengagement speed,

[2] The INDIRECT macro provides confidence intervals (CIs) for unstandardized coefficients only. To obtain standardized coefficients, analyses were run a second time using standardized variables (z-scores) following the estimation of CIs (see Hayes, 2012). As such, presented CIs are for the *unstandardized* coefficients only.

Table 2

Correlation table

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. GNAT-log	-	-.13	-.02	-.18*	-.16	.00	.00	.15	.18*	.20*	.27**	.16	.16
VST Indices	-	-	-	-	-	-	-	-	-	-	-	-	-
2. DG speed (ms)	-	-	.53**	-.14	-.32**	-.05	.10	-.26**	-.28**	-.26**	-.21*	-.-09	-.08
3. EG speed (ms)	-	-	-	-.32**	-.35**	-.03	.07	-.22*	-.20*	-.22*	-.12	-.04	-.12
4. DG accuracy (%)	-	-	-	-	.56**	-.08	-.03	-.13	-.13	-.12	.04	.03	.02
5. EG accuracy (%)	-	-	-	-	-	-.08	.03	.01	.02	.02	-.02	.00	.03
6. BAI	-	-	-	-	-	-	.65**	.06	.18*	.16	-.08	-.05	.06
7. BDI	-	-	-	-	-	-	-	-.02	.07	.11	-.05	-.01	.05
8. FSQ	-	-	-	-	-	-	-	-	.84**	.70**	.14	.24**	.30**
9. SPQ	-	-	-	-	-	-	-	-	-	.67**	.12	.20*	.26**
10. SRs	-	-	-	-	-	-	-	-	-	-	.10	.21*	.31**
11. SUDS Pretest	-	-	-	-	-	-	-	-	-	-	-	.72**	.61**
12. SUDS PostGNAT	-	-	-	-	-	-	-	-	-	-	-	-	.87**

13. SUDS PostVST	-	-	-	-	-	-	-	-	-	-	-	-	-

* $p < .05$, ** $p < .01$;; GNAT-log = log-transformed Go/No-go Association Task; VST = visual search task; DG = Disengagement; EG = EngagementBAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; FSQ = Fear of Spiders Questionnaire; SPQ = Spider Phobia Questionnaire; SRs = stimulus ratings; SUDS = subjective units of distress scale, anxiety items

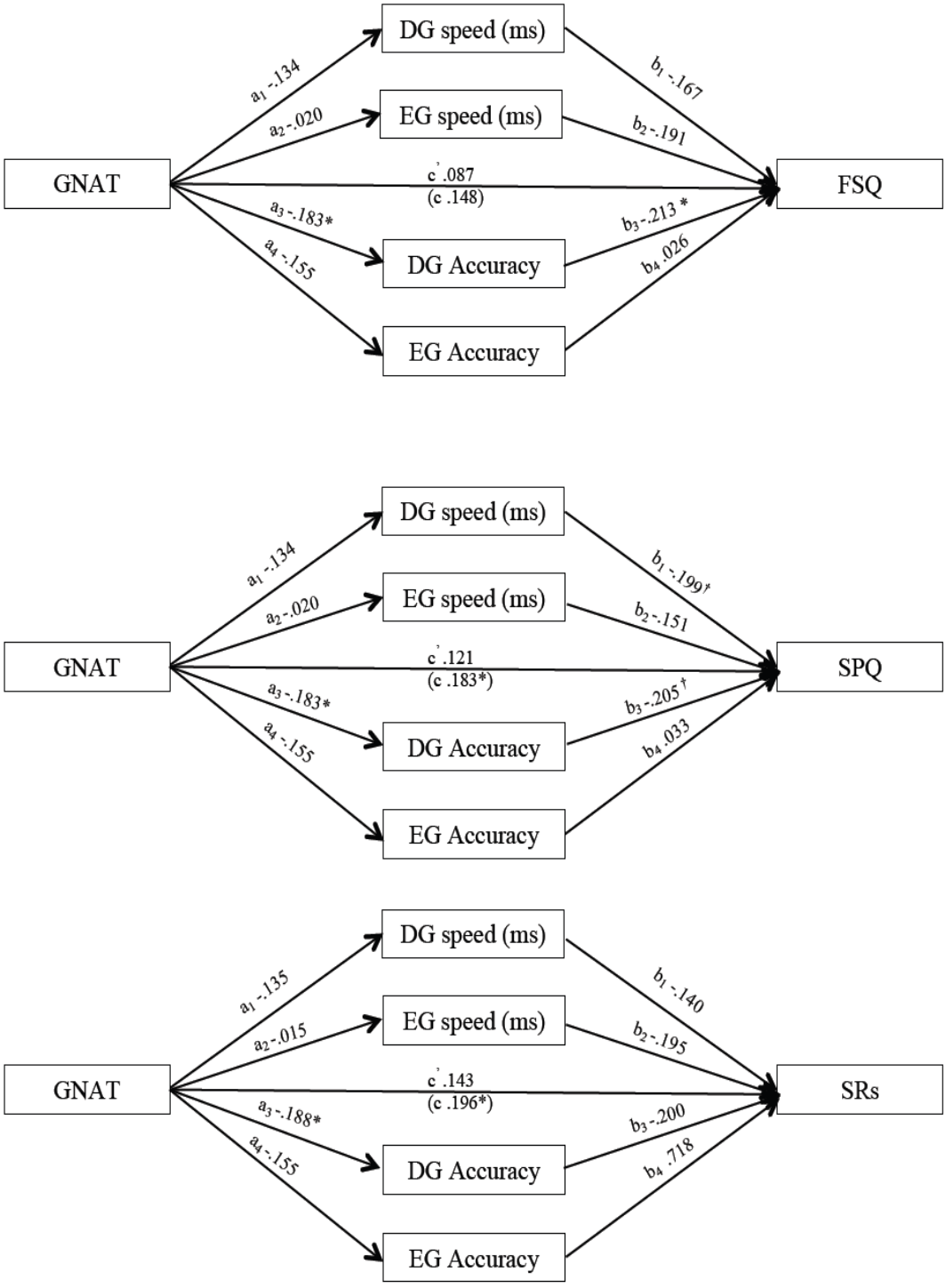
(2) Engagement speed, (3) Disengagement accuracy, and (4) Engagement accuracy. The three models were different from one another in the dependent variable only. A separate mediation analysis was therefore conducted for each of three measures of reported spider fear: (1) FSQ, (2) SPQ, and (3) mean ratings of spider stimuli as anxiety-provoking (See Figure 3 for models and standardized coefficients).

FSQ. Results demonstrated that of the four mediators, spider-fear associations predicted only disengagement accuracy (unstandardized b = -.35, SE = .17, t = -2.07, p < .05). Similarly, scores on the FSQ were predicted only by disengagement accuracy (unstandardized b = 60.04, SE = 29.97, t = -2.00, p < .05). For both relationships, higher levels of spider fear (indirect and direct) were related to lower levels of disengagement accuracy. No significant relationship between spider-fear associations and reported spider fear was observed. Overall, the model significantly accounted for 12.62% of the variance in FSQ scores (F[5, 120] = 3.47, p < .006). Moreover, percentile confidence intervals (CIs) indicated that spider-fear associations exerted a significant indirect effect on reported spider fear via disengagement accuracy only (95% CI: .05 - 65.51). The total indirect effect of all mediators was not significant (95% CI: -1.50 - 83.45).

SPQ. Similar to analyses using the FSQ as the dependent variable, disengagement accuracy was the only mediator predicted by spider-fear associations (unstandardized b = -.35, SE = .17, t = -2.07, p < .05). There were also trends for disengagement speed (unstandardized b = -.005, SE = .002, t = -1.91, p < .06) and disengagement accuracy (unstandardized b = -12.23, SE = 6.31, t = -1.94, p < .06) to predict scores on the SPQ. Examination of the directionality of such effects suggested that faster, but less accurate performance on disengagement trials was related to higher levels of reported spider fear.

Figure 3

Mediational models



* $p < .05$, † $p < .06$; all values are standardized coefficients; a_n = effects of IV on mediators; b_n = effects of mediators on DV; c = total effect of IV on DV; c' = direct effect of IV on DV; GNAT = Go/No-go Association Task; DG = Disengagement; EG = Engagement; FSQ = Fear of Spiders Questionnaire; SPQ = Spider Phobia Questionnaire; SRs = stimulus ratings

SPQ scores were significantly predicted by spider-fear associations (unstandardized b = 20.65, SE = 9.95, t = 2.08, $p < .05$), however this relationship became nonsignificant after accounting for the mediators (unstandardized b = 13.66, SE = 9.93, t = 1.38, *n.s.*). Overall, the model significantly accounted for 13.58% of the variance in reported spider fear (F[5, 120] = 3.77, $p < .004$). Spider-fear associations demonstrated an indirect relationship with reported spider fear via disengagement accuracy only (95% CI: .06 - 13.72).

Spider ratings. Because of a computer error, fear-relevance ratings of spider stimuli were unavailable for 1 participant. Results of the multiple mediation analyses (n = 125) indicated that spider-fear associations predicted only disengagement accuracy (unstandardized b = -.35, SE = .17, t = -2.11, $p < .05$). No mediators emerged as significant predictors of spider ratings. The total effect of spider-fear associations on reported spider fear was significant (unstandardized b = 2.19, SE = .98, t = 2.22, $p < .05$), but was no longer significant after accounting for the proposed mediators (direct effect; unstandardized b = 1.59, SE = .99, t = 1.61, *n.s.*). Overall, the model accounted for 13.18% of the variance in reported spider fear, which was a significant effect (F[5, 119] = 3.61, $p < .005$). As with the FSQ and SPQ, spider-fear associations exerted a significant indirect effect on spider ratings via disengagement accuracy only (95% CI: .02 - 1.34).

Discussion

The current study was designed to test the hypothesis that strong spider-fear associations predict impaired (i.e., slower) disengagement from spiders, which in turn, predicts increased reported spider fear. Results were partially consistent with hypotheses. Multiple mediation models provided evidence for the contention that associative links in

memory are related to attention bias and explicit fear. To our knowledge, this is the first study which demonstrates a meditational relationship between indirect and direct measures of anxiety via cognitive bias; however, the pattern of attention processes diverged from previous literature. Specifically, strong spider-fear associations predicted less accurate disengagement from spiders, which subsequently predicted higher levels of reported spider fear. Moreover, the pattern of correlations suggested that higher spider fear was related to *faster* disengagement, which is in contrast with a large body of research clearly demonstrating slower disengagement from feared stimuli.

Recent conceptualizations of anxiety implicate information processing not only in its maintenance, but also in its aetiology (e.g., Mathews & MacLeod, 2005; Ouimet et al., 2009). Basic cognitive theory centers on the idea that cognition causes affect (Beck & Emery, 1985); however, with the exception of one prospective study (MacLeod & Hagan, 1992), the majority of studies examining cognitive bias and anxiety have been correlational in nature. A recent surge in the literature examining the effects of experimentally manipulating cognitive bias on emotional vulnerability has provided some support for the hypothesis that attention bias may contribute to the development of anxiety disorders (e.g., MacLeod, Campbell, Rutherford, & Wilson, 2004). Several studies have demonstrated the efficacy of cognitive bias modification in the treatment of generalized anxiety disorder and social phobia, as well as the reduction of high trait anxiety (see Bar-Haim, 2010, for a review). Moreover, successful CBT treatment of anxiety symptoms is associated with a decrease in attentional bias (Tobon, Ouimet, & Dozois, 2011). Although the current study cannot demonstrate causality because of the lack of manipulation of cognitive bias, results are consistent with the contention that

cognitive bias can precede (at least statistically) reported fear. Furthermore, our findings extend those of previous studies by incorporating the associative system as a fundamental cognitive system, which influences cognitive processes associated with disengagement from threatening stimuli. It is important to note, however, that due to the correlational nature of the current study, these findings may also be consistent with other theories or patterns of causality, which were not tested in the current study. It will be important to manipulate these variables experimentally in future research to better elucidate the possible directions of causality.

Research has consistently demonstrated the existence of attention biases amongst anxious samples, regardless of posited direction of causality (Bar-Haim et al., 2007). Additionally, recent research has demonstrated that indirect measures of spider fear (i.e., 'implicit' spider fear and impaired disengagement) jointly predict more 'automatic' behaviour such as autonomic response to a spider, whereas direct measures of spider fear (i.e., self-report questionnaires or 'explicit' fear) best predict more 'controlled' behaviour such as avoidance of a spider; indirect and direct measures of spider fear were uncorrelated (Van Bockstaele et al., 2011a). In line with these findings, we contend that implicit and explicit fear likely exert distinct influences on physiological reactions, fearful behaviour, and self-reported fear; however, research also supports a small but important relationship between direct and indirect measures (Teachman, 2007). Our finding that higher spider-fear associations were correlated with measures of reported spider fear, but not measures of general anxiety or depression suggest that increased match between direct and indirect measures likely increases the observed relationship between 'implicit' and 'explicit' processes (cf., Rydell & McConnell, 2010). Moreover,

meditational models suggested that this relationship was indirect in nature, via reduced disengagement accuracy. Examination of patterns of correlation, however, indicated distinct relationships between attentional bias and direct and indirect measures of spider fear. Specifically, when measured indirectly (i.e., GNAT), spider fear was associated with disengagement accuracy only. When measured directly (i.e., FSQ, SPQ, SRs), however, spider fear demonstrated correlations with engagement and disengagement speed, but not accuracy, highlighting the importance of assessing cognitive bias as a multi-stage process.

The finding that threat-relevant attention bias occurs amongst anxious samples is robust (Bar-Haim et al., 2007). Attention, however, consists of ordered, but overlapping stages (e.g., Posner, 1980) which may exert distinct, but related influences on the development and maintenance of anxiety (Ouimet et al., 2009). Moreover, research examining the existence of biases at each stage of processing has provided equivocal results. These findings, in tandem with those of our study, highlight the importance of methodologically rigorous studies which assess various components of attentional bias. By evaluating accuracy, speed, and response slowing on measures of orientation, engagement, disengagement, and avoidance, the effects of such processes on the aetiology and maintenance of anxiety disorders may be clarified.

Consistent with prior research, participants in the current study were quicker to find spiders among neutral distractors (i.e., beetles, butterflies and/or dragonflies) than they were to detect the presence of a neutral target among typically fear-relevant distractors (e.g., Flykt, 2006). Because all stimuli used in the current study were from a similar animal class (i.e., both targets and distractors were bugs; most prior research

involved finding spiders in matrices of flowers or mushrooms), our findings provide support for the contention that the fear-relevance of the stimulus rather than the physiological distinctness of the target or distractors likely drives observed differences in reaction times. However, contrary to previous research, higher spider fear was associated with faster as opposed to slower detection of neutral targets among spider distractors. Additionally, differences in accuracy were noted, wherein all participants were least accurate on disengagement trials and most accurate on engagement trials; with an enhanced effect observed among more highly spider fearful participants.

Our visual search task closely modeled the odd-one-out task described by Rinck et al. (2005). Whereas those researchers selected their participants into high- and low-spider fearful groups based on scores on self-report measures of spider fear, our participants were unselected for spider fear, with the assumption that their fear levels would fall along a broad continuum. For our sample, approximately 30% of participants fell within the "high fearful" range delineated by Rinck et al. As such, it is possible that the typical high fear-slow disengagement relationship is detected only when comparing highly fearful and non-fearful participants. Although not tested statistically, a brief exploration of possible groups in our sample indicated that participants who fell within the top third of spider fear on both indirect and direct measures of spider fear (n = 20) were faster to disengage from spiders (*mean RT* = 1966.43, *SD* = 461.68) than were individuals who fell within the bottom third of both indices (n = 17, *mean RT* = 2398.58, *SD* = 267.22), mirroring the results of our correlations. Therefore, it is unlikely that the divergence of our results from previous research is attributable to nonclinical levels of spider fear.

Participants in the current study evidenced reaction times similar to those reported by Rinck et al. (2005), but substantially longer than those described in other studies using visual search paradigms, albeit with varying methodologies. Indeed, participants in our study demonstrated mean response times in excess of 2 seconds, which is substantially longer than what is typically observed in studies assessing attention bias. Given these longer response times, it is possible that, consistent with vigilance-avoidance models of attention (e.g., Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006), high spider-fearful participants were faster than low spider-fearful participants to detect a neutral stimulus amongst spiders because of posited later-stage processing avoidance tendencies. In other words, effortful avoidance of spider distractors may have lead to more efficient detection of neutral targets.

In tandem with the discrepant response time findings, results of the current study included differences in accuracy on the visual search task. Taken together, these findings suggest that the spider VST may not represent a "pure" measure of disengagement, but likely assesses related processes including attentional capture, appraisal, and task-switching. For example, given the observed reduced disengagement accuracy associated with increased spider fear, it is possible that highly spider fearful participants were more likely to erroneously identify target bugs (e.g., beetles) as spiders, thereby decreasing their accuracy. As such, this task may not have offered an appropriate test of the original study hypothesis. Future studies investigating the relationships between spider-fear associations, impaired disengagement, and reported spider fear should endeavour to use tasks that reduce the influence of variables such as working memory load, set-shifting, and emotional arousal on indices of disengagement speed.

The role of rule-based or 'controlled' processes may be particularly important in clarifying the results of the current study. Given the longer response times, it is likely that such processes influenced the accuracy and rate of responding on the VST (Ouimet et al., 2009). For example, participants with strong spider-fear associations and adaptive rule-based coping skills may have been adept at discriminating between spiders and "other bugs", thereby decreasing the mean reaction time for high spider-fearful participants on relevant trials. Moreover, research has consistently demonstrated a negative interpretive bias among anxious participants (e.g., Becker & Rinck, 2004; de Jong & Muris, 2002; Salemink, van den Hout, & Kindt, 2010). Therefore, it is possible that spider fearful participants in the current study were faster to identify spider distractors as such, perhaps facilitating performance on disengagement trials. They may also have been likely to misinterpret other bugs (e.g., beetles) as spiders, thereby contributing to correlations between reduced accuracy and higher spider fear. Future research examining the interplay between associative and rule-based processes in fear-relevant attention bias is essential.

Finally, the current study provides evidence for the importance of understanding basic cognitive processes such as those of the associative system. Indeed, strong fear-related associative links in memory may be part of a broad vulnerability factor for emotional disorders. Continued investigation of the roles played by the associative and rule-based systems may help us to develop and refine current efficacious treatments of anxiety disorders. For example, it is possible that although cognitive restructuring effectively targets explicit beliefs related to the danger of spiders, strong associative links between the concepts of 'spider' and 'fear' remain, thereby influencing an individual's fearful or avoidant behaviour. Treatments that target both associative (e.g., by

encouraging successful interactions with spiders) and rule-based (e.g., by practicing cognitive reappraisal of feared stimuli) factors involved in the perpetuation of anxiety may see their effectiveness enhanced.

CHAPTER 3:

BRIDGE

A recent model of cognitive vulnerability to anxiety posits that individual differences in associative and rule-based processing may help to explain discrepant findings related to the time-course of observed attentional biases among anxious samples (Ouimet et al., 2009). Study 1 was designed to investigate one component of this model in relation to spider fear: that stronger spider-fear associative links in memory would predict impaired disengagement from spider stimuli, which would subsequently predict higher levels of reported spider fear. Undergraduate student participants completed computerized tasks assessing the strength of their associations between spider and fear (relative to spider and calm), and both the speed and accuracy with which they engaged with and disengaged from spider stimuli on a visual search task. Subsequently, they completed self-report questionnaires of spider fear and avoidance.

Results demonstrated, consistent with previous literature, that overall, participants were slowest on disengagement trials and fastest on engagement trials. In contrast with previous literature and hypotheses however, higher levels of reported spider fear were correlated with faster engagement with and disengagement from spiders. Moreover, significant differences in accuracy were noted: participants were least accurate on disengagement trials and most accurate on non-spider trials. Stronger spider-fear associations were correlated with reduced disengagement accuracy.

A series of meditational models (using Bootstrapping methods) was conducted. Results generally demonstrated an indirect relationship between spider-fear associations, disengagement accuracy, and reported spider fear. Specifically, stronger spider-fear

associations predicted reduced disengagement accuracy, which subsequently predicted increased reported spider fear. The amount of variance accounted for by these models was small, and varied depending on which questionnaire was entered as the criterion variable (12.62% – 13.58%). Given these findings, it is important to investigate the potential role played by rule-based processing. Indeed, recent research has demonstrated that attentional control may moderate attention to threat-relevant faces (Barratt & Bundesen, 2012; Susa, Pitică, Benga, & Miclea, 2012).

Gawronski and Bodenhausen (2006) contend that evaluation of associations activated by the associative system is accomplished via the rule-based system in one of three ways: (1) affirmation, (2) negation, or (3) reappraisal. The type of appraisal used is further hypothesized to influence the point at which a spider-fearful person is able to disengage from spider stimuli (Ouimet et al., 2009). Specifically, repeated negation of spider-fear associations is posited to lead to ironic strengthening of spider-fear associations and consequently, impaired disengagement and increased reported spider fear, whereas the opposite pattern is expected following repeated reappraisal of spiders as safe. Study 2, therefore, was designed to examine the effects of experimental manipulation of rule-based processing on patterns of attentional responding to spider stimuli and reported levels of spider fear. In this study, unselected volunteer participants were randomly assigned to either repeatedly negate or repeatedly reappraise the threat-value of spiders. Subsequently, they completed a visual search task and spider-fear questionnaires as described in Study 1.

CHAPTER 4:

THE EFFECTS OF REPEATED NEGATION AND REPEATED REAPPRAISAL ON THREAT-RELATED ATTENTION AND SPIDER FEAR

A substantive body of literature supports the existence of threat-relevant attentional biases among anxious samples (see Bar-Haim et al., 2007, for a recent meta-analysis). Discrepant findings across experiments, however, suggest that the *stage* at which attention biases occur is less clear (Ouimet et al., 2009). Specifically, attention is believed to occur across multiple stages: (1) orientation, (2) engagement, (3) disengagement, and (4) avoidance. Both supportive and contradictory evidence for threat-relevant bias has emerged at each of these stages (e.g., Fox, Russo, Bowles, & Dutton, 2001; Osinsky et al., 2008; Thorpe & Salkovskis, 1997; van den Hout, Tenney, Huygens, & de Jong, 1997). A recent model of cognitive vulnerability to anxiety contends that inconsistent findings related to the time-course of attentional bias may be explained by individual differences in associative and rule-based processing (Ouimet et al., 2009).

Dual-Systems Models of Cognition

Although the features of associative and rule-based processing may be similar to those that describe automatic (e.g., outside of consciousness, unintentional, uncontrollable, effortless) and strategic processes (e.g., conscious, intentional, controllable, effortful) (Bargh, 1994), their operating principles are distinct (Gawronski & Bodenhausen, 2009). Indeed, it is the process by which these systems function (i.e., associative vs. rule-based), and not their characteristics (e.g., automatic vs. controlled, conscious vs. unconscious, implicit vs. explicit) that are the focus of this study. Associative processing involves the rapid activation of associated concepts in memory,

whereas rule-based processing entails the evaluation of factual relationships among cognitive concepts. The systems have been proposed to work in parallel to problem-solve (e.g., Sloman, 1996), evaluate and change social judgments (e.g., Gawronski & Bodenhausen, 2006), regulate emotions (e.g., Smith & Neumann, 2005), and influence behaviour (e.g., Deutsch & Strack, 2006); however, the responses produced by each system can conflict. This conflict may underlie divergent evidence related to the time-course of responding to threat-relevant stimuli in anxious samples (Ouimet et al., 2009). Specifically, the interplay between individual differences in threat-relevant associative network strength and effective use of rule-based reasoning to evaluate the threat level of the stimuli may determine when an individual will disengage his/her attention from threat-relevant stimuli.

For example, when exposed to a spider, the associative system of a spider fearful individual may activate strongly related concepts such as 'fear' and 'danger'. This rapid activation of fear-related concepts is hypothesized to enhance initial orientation and engagement with the spider (Ouimet et al., 2009). The rule-based system, simultaneously activated by exposure to the spider, is posited to evaluate whether the activated associations are legitimate (e.g., is the spider actually dangerous?). Continued engagement with the stimulus and continued activation of fear-related concepts in the associative system is believed to heighten the likelihood of a threatening appraisal of the spider, thereby potentially increasing engagement and making disengagement more difficult. Alternatively, reappraisal of the spider as safe/neutral may override the associative system, potentially facilitating disengagement from the spider and weakening spider-fear associative links over time.

Associative processing in spider fear. Because of the assumed 'implicit' or 'unconscious' nature of associative networks, several inventive methodologies have been used to measure such constructs in social phobia (Dozois & Frewen, 2006; de Jong, 2002), specific phobia (Huijding & de Jong, 2005; Teachman & Woody, 2003), posttraumatic stress disorder (Engelhard, Huijding, van den Hout, & de Jong, 2007), depression (Dozois et al., 2009; Gemar, Segal, Sagrati, & Kennedy, 2001), and in association with alcohol use (Houben & Wiers, 2008) and other substance use disorders (Rooke, Hine, & Thorsteinsson, 2008). These paradigms typically rely on reaction times in response to stimulus pairs as a measure of their relatedness (e.g., faster to respond to spider pictures when paired with 'fear' than when paired with 'calm').

Research among spider fearful participants has demonstrated stronger links between 'danger' and 'spider' relative to 'snake' (Teachman, Gregg, & Woody, 2001), stronger spider-fearful networks compared to low-fearful participants (e.g., Ellwart, Becker, & Rinck, 2005; Huijding & de Jong, 2005; Teachman, 2007), reduced spider-fear associations following exposure therapy (Teachman & Woody, 2003), and the prediction of spider-fearful responses and behaviour over and above overt measures of spider fear (Ellwart, Rinck, & Becker, 2006; Huijding & de Jong, 2005; Rinck & Becker, 2007; Teachman, 2007). Moreover, recent research has examined relationships between spider-fear associations, attention bias, and spider fear.

Van Bockstaele et al. (2011a) found that stronger spider-fear associations were correlated with impaired disengagement from spider stimuli. Additionally, experimental reduction of spider-relevant attention bias using a modified dot-probe task did not result in decreased spider-fear associations (Van Bockstaele et al., 2011b), suggesting that such

associations are not merely cognitive by-products of existing biases. Ouimet, Radomsky, and Barber (2012) demonstrated that spider-fear associations exerted an indirect effect on reported spider fear via reduced disengagement accuracy on a visual search task. Effect sizes for the influences of associative processes are generally small to moderate (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; W. Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005; Nosek, 2005); investigation into the effects of rule-based processing may help to elucidate the nature of cognition in anxiety.

Rule-based processing in spider fear. Cognitive models of anxiety contend that anxious individuals show negative interpretive biases for neutral information (e.g., Salemink, van den Hout, & Kindt, 2010). For example, clinically anxious individuals are more likely to disambiguate various scenarios as threatening compared to recovered clinically anxious and never anxious samples (Amir et al., 2005). Although it may seem intuitive to categorize interpretative and attentional biases as rule-based and associative processes, respectively, contemporary models of cognition argue that most stages of processing are likely influenced by both systems (Cisler & Koster, 2010; Ouimet et al., 2009). As such, although interpretation is likely driven by the rule-based system, it is heavily influenced by the associative system (Ouimet et al., 2009). Therefore, research pertaining to interpretive biases provides a proxy measure of rule-based processing, but cannot be separated completely from associative processing.

Individuals with spider fear are more likely to interpret ambiguous stimuli as spider-related than are their non-fearful counterparts (e.g., Becker & Rinck, 2004), and overestimate the co-occurrence of spider stimuli and electric shock (e.g., de Jong, Merckelbach, & Arntz, 1995), as well as the probability that spiders will approach them

(de Jong & Muris, 2002). Moreover, interpretation bias may occur in the early stages of stimulus perception. Vasey et al. (2012) recently demonstrated that individuals who reported higher fear during exposure to a spider also estimated the size of the spiders to be larger. Finally, recent research suggested that the tendency to exhibit negative interpretive biases while in a negative mood state may be observed only among those with low regulatory control (a potential indicator of maladaptive rule-based processing) (Salemink & Wiers, 2012).

In an examination of the potential causal role of interpretive bias in spider fear, Teachman and Addison (2008) randomly assigned spider fearful individuals into one of three interpretive training conditions: (1) positive, (2) neutral, or (3) no training. Following training, individuals in the positive condition were faster to generate positive interpretations than were individuals in the neutral condition. This interpretive manipulation, however, had no group effects on avoidance or subjective distress upon exposure to a live spider. A significant correlation between response latency to positive probes (i.e., positive interpretation bias) and fear and avoidance during a behavioural approach task (BAT), while controlling for negative interpretive bias during the first half of the task, provided some support for the hypothesis that interpretive training influenced reactivity to a spider task. However, as mentioned, this did not occur at the group level. Therefore, although interpretive training was successful, it exerted minimal effects on vulnerability to spider fear. These results are partially inconsistent with cognitive theories of anxiety which posit that affective change is mediated by cognitive change (e.g., Mathews & MacLeod, 2005).

The positive training condition used by Teachman and Addison (2008) involved disambiguating spider-related scenarios. For example, participants were asked to complete the word string in the following scenario: "You wake up in the middle of the night and see something on your alarm clock. You realize it is a spider. You think that it is (h--mless)," and then to answer the question "Is the spider a threat?" (pp. 451-452). The only correct answer to the word completion task would be "harmless", which in itself is a negation. Participants were subsequently asked to negate the harm value of a spider by responding "no" to the follow-up question. Research in the social-cognitive area, however, has demonstrated that negation has ironic effects on subsequent attitudes (Gawronski, Deutsch, Mbirkou, Seibt, & Strack, 2008). As such, activation of the links between "harmlessness" and "spider" and between "no threat" and "spider" may activate the link between the dimension of harm and the concept of spider, which subsequently is hypothesized to lead to rapid spreading of activation to other associated concepts in memory, thereby potentially reinforcing, rather than disintegrating, established spider-fear related links.

Indeed, Gawronski et al. (2008) demonstrated that only repeated affirmations of counterstereotypes (e.g., strong women) resulted in changes in stereotypic attitudes. When participants were asked to repeatedly negate extant stereotypes (e.g., say "NO" to the pairing of "women" with "weak"), stereotypic associations were strengthened. It may be therefore, that in Teachman and Addison's (2008) study, although negation of harm by the rule-based system led to decreased overt interpretation of spider stimuli as threatening, it ironically increased the strength of spider-related fear networks in the associative system, resulting in mixed effects on spider fear and related behaviour.

Consistent with the multi-process model of attention bias in anxiety (Ouimet et al., 2009), the current study was designed as a preliminary test of the hypothesis that repeated negation of spider-fear associations would result in impaired disengagement from spider stimuli and subsequently, higher levels of reported spider fear; repeated reappraisal of spiders as safe, however, was hypothesized to lead to facilitated disengagement from spider stimuli and subsequently, lower levels of reported spider fear. As such, a novel paradigm (the Non-Stereotypic Association Task [NSAT], described below) was employed to manipulate the extent to which existing spider-fear associations were activated. Although similar to cognitive bias modification paradigms (CBM), the NSAT is an experimental manipulation, not a form of CBM. Participants were randomly assigned either to repeatedly negate the fear-value of spiders or to repeatedly reappraise spiders as safe. They subsequently completed a visual search task and a battery of behavioural and affective measures. Because the NSAT was designed to activate extant associations, differences were expected only on those measures assessing spider fear. It was expected that the activation of existing spider-fear associations among participants in the Negate condition would lead to greater endorsement of items on the self-report spider fear measures, not because of changes in symptoms, *per se*, but because of greater cognitive availability of beliefs and experiences consistent with a fearful evaluation of spiders. Again, because the NSAT was expected to activate only spider-fear associations, general mood measures (e.g., BAI, see below) were not expected to differ between groups.

Moreover, particular care was taken to minimize the effects of expectancy bias. Therefore the NSAT also required participants to negate the "calm-value" of butterflies,

or to reappraise butterflies as fear-related. Because it is unlikely that participants have strong emotional associations with butterflies in memory, this task was not expected to activate consistently any butterfly-emotion associations. Additionally, no pre-manipulation measures of spider fear or attention bias were obtained, to avoid the likelihood of participants believing the NSAT was intended as a cognitive or emotional manipulation.

Method

Participants

Participants were 134 undergraduate student volunteers (77.6% female; mean age = 23.70, SD = 6.56 years) at Concordia University in Montreal, Canada, compensated with course credit or with entry in a draw for cash prizes. The majority of participants was of European descent (69.4%) and was single (86.6%).

Apparatus

A Dell Precision T1500 desktop computer with a 22-inch monitor (30 cm x 48 cm) was used to administer all instructions, questionnaires, and cognitive tasks. Participants were seated approximately 65 cm (~25") from the monitor and responded to stimuli using a standard keyboard.

Self-report Questionnaires

Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995). Fear and avoidance of harm from spiders were measured using the FSQ. Using an 8-point Likert-type scale, participants rated the extent to which they agreed (0 = totally disagree, 7 = totally agree) with 18 statements such as "If I saw a spider now, I would ask someone else to kill it." The FSQ demonstrates excellent internal consistency ($\alpha = .92$; Szymanski

& O'Donohue, 1995), test-retest reliability (r = .91), and good convergent and discriminant validity (Muris & Merckelbach, 1996).

Spider Phobia Questionnaire (SPQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974). The SPQ is a 31-item true-false measure, which assesses cognitive and behavioural indices of spider fear such as "If someone says that there are spiders anywhere about, I become alert and edgy." The SPQ demonstrates excellent internal consistency ($.95 < \alpha < .97$), test-retest reliability (r = .94), and differentiates between individuals with and without spider phobia (Muris & Merckelbach, 1996).

Beck Anxiety Inventory (BAI; Beck & Steer, 1993). The BAI consists of 21 items related to symptoms of anxiety (e.g., shaky, choking, terrified) experienced over the preceding week. The BAI is a frequently used measure of anxiety with well-established psychometric properties (e.g., Osório, Crippa, & Loureiro, 2011).

Beck Depression Inventory-II (BDI; Beck, Steer, & Brown, 1996). The BDI is a 21-item questionnaire that asks respondents to rate the degree to which they have experienced symptoms of depression (e.g., sadness, loss of pleasure, indecisiveness, changes in appetite) during the past two weeks. The BDI has well-established psychometric properties (Dozois & Covin, 2004).

Subjective Units of Distress Scale (SUDS; Wolpe, 1958). For the SUDS, respondents rate their level of state distress on a scale from 0 (*no distress*) to 100 (*extreme distress*). These ratings have demonstrated correlations with physiological measures of stress (Thyer, Papsdorf, Davis, & Vallecorsa, 1984). Similar to Ouimet et al., (2012), participants completed the original SUDS as well as 3 modified versions assessing feelings of happiness, frustration, and sleepiness.

Stimulus ratings. Participants completed a measure designed for a previous study (Ouimet et al., 2012), for which they were asked to assess the subjective pleasantness and fear-relevance of all presented stimulus categories. Participants were asked to indicate on a 7-point Likert-type scale the extent to which they found 2 random exemplars of each stimulus category (spider, butterfly, dragonfly, beetle; 8 items total) pleasant (0 = extremely unpleasant; 6 = extremely pleasant), how fearful they were of each stimulus (0 = no fear; 6 = terror), and how easily they were able to recognize each stimulus (0 = extremely unrecognizable; 6 = extremely recognizable). For all self-report questionnaires, internal consistency within the current sample is presented in Table 3.

Cognitive Tasks

Non-stereotypic association task (NSAT). The NSAT, modified from Gawronski et al. (2008), was designed to manipulate the activation of spider-fear associations in memory through two different methods of rule-based processing. Participants were asked either to repeatedly negate or to repeatedly reappraise the stereotypic emotional reaction to spiders. Specifically, they were asked to respond with a key-press to stimulus pairs of pictures (spiders or butterflies) and attributes (calm- or fear-related; see Figure 4). Participants were randomly assigned to either the reappraise (RA) or negate (NG) condition. Participants assigned to the RA condition were presented with the following instructions, modified from Gawronski et al. (2008; pp. 372):

> The following task is concerned with the emotional stereotypes associated with spiders and butterflies. As you probably know, people are often afraid of spiders, while they usually feel calm around butterflies. This reaction, however, is based on a stereotype that may or may not be true. In the following task, you will be presented with pictures of spiders and butterflies. In addition, you will be presented with words relating to fear and calmness that will appear on the screen shortly after the pictures. Your task is to respond "YES!" with the

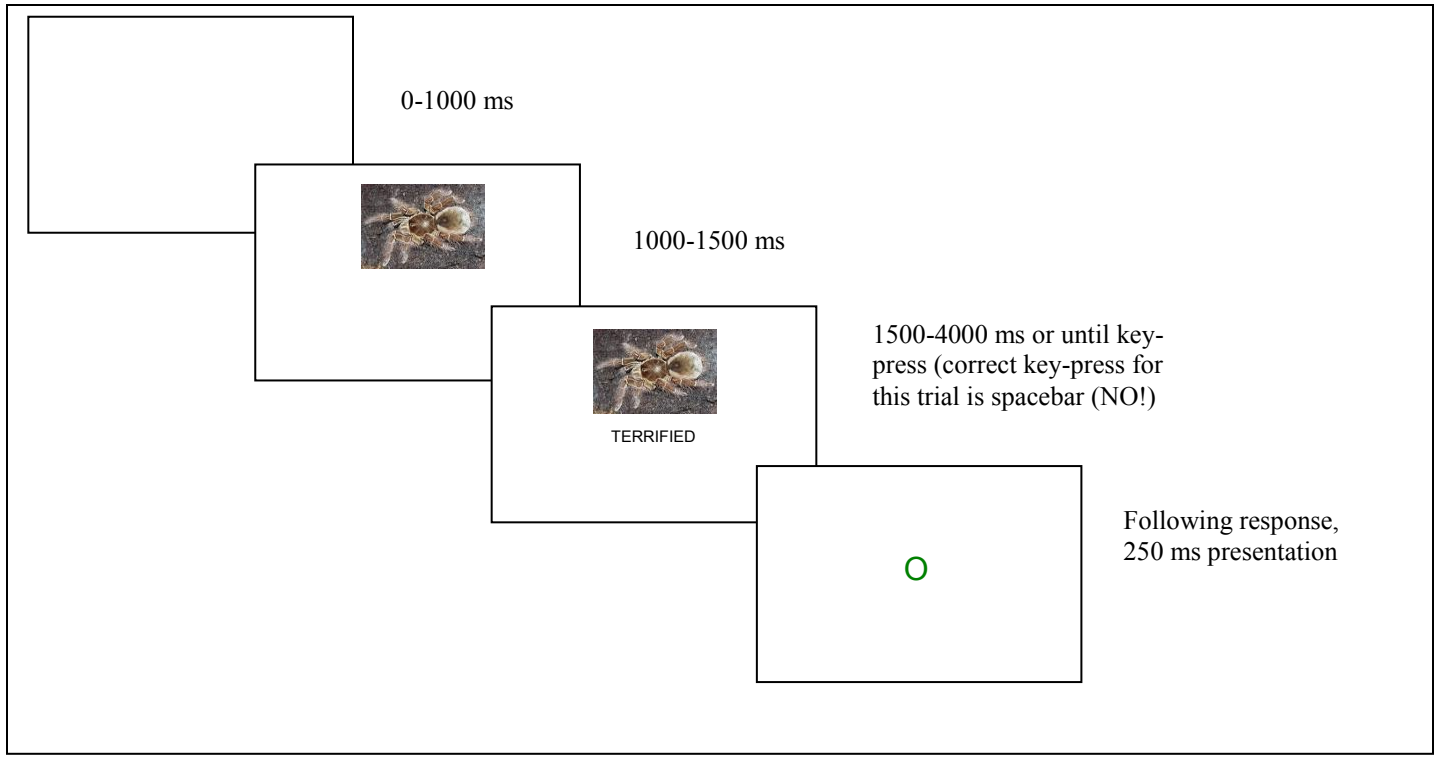


Figure 4. Example of a correct response on a spider-afraid trial in the NG condition on the Non-Stereotypic Association Task (NSAT).

> spacebar each time you see a SPIDER picture and a word relating to "CALM", or a BUTTERFLY picture and a word relating to "AFRAID". Please pay very close attention to combinations that are INCONSISTENT with the emotional stereotype of spiders and butterflies! For combinations that are consistent with the emotional stereotype of spiders and butterflies, you do not have to do anything. Again, please respond "YES!" with the spacebar each time you see a combination that is INCONSISTENT with the emotional stereotype of spiders and butterflies. Please try to respond as QUICKLY and as ACCURATELY as possible!"

Participants in the NG condition received identical instructions, but were told to respond "NO!" by pressing the space bar in response to pairings that were *consistent* with emotional stereotypes.

Similar to Gawronski et al. (2008), participants were presented with 10 practice trials (5 each of stereotype-consistent and inconsistent, using the same stimuli as the critical trials) followed by 200 critical trials, composed of 50 trials for each of 4 types of stimulus-emotion pairings: (1) spider picture+calm-related word; (2) butterfly picture+calm-related word; (3) spider picture+fear-related word; (4) butterfly picture+fear-related word. For participants in the RA condition, correct responses consisted of spacebar presses (*YES!*) in response to types (1) and (4), and no response to types (2) and (3). Correct responses for participants in the NG condition were spacebar presses (*NO!*) to types (2) and (3), and no response to types (1) and (4). Stimulus pairings were created randomly by the software program Inquisit 3.0 (2009); every stimulus was presented once before any were repeated, and no exact stimulus pairing was repeated.

Each trial began with the presentation of a 'bug' picture centered in the top half of the screen. Following 500 ms, an emotional attribute was presented directly underneath the still present picture. For all trials, stimulus pairs were presented for a maximum of 2,500 ms; spacebar presses resulted in the disappearance of the stimulus pairs. Feedback

was provided for all trials (250 ms). Correct responses were followed by a green "O" presented in the center of the screen; incorrect responses were followed by a red "X". An interstimulus interval (ISI) of 1,000 ms following error/correct feedback was consistent across trials. Trials were presented in 5 blocks of 40 trials each, in between which participants were offered the chance to rest briefly.

Stimuli. Pictorial stimuli included twenty 12 cm by 12 cm colour pictures each of spiders and butterflies. Lexical stimuli consisted of 20 calm-related (e.g., relaxed, serene) and 20 fear-related words (e.g., terrified, scared) presented in white Arial font (all capital letters), sized to occupy 5% of the screen (1.5 cm in height). All stimuli were piloted for recognizability, valence, and fear-relevance in a previous study (Ouimet et al., 2012), and were presented on a black background.

Visual search task (VST). The VST, which assessed engagement with and disengagement from spiders, was identical to the paradigm described in Ouimet et al. (2012); a detailed description is provided therein. For all trials, participants were presented with a 4 x 4 matrix of 16 'bug' pictures and were instructed to press a *yes* button on the keyboard if they detected a discrepant stimulus (i.e., odd-one-out) among 15 categorically homogenous stimuli, or to press a *no* button on the keyboard if all the stimuli within a matrix belonged to the same bug category (i.e., spider, butterfly, beetle, or dragonfly). The task consisted of 130 trials: 24 engagement, 24 disengagement, 36 control, 40 target absent, and 6 practice trials.

For engagement trials (see Figure 2), the "odd-one-out" consisted of a spider target among a matrix of beetles, butterflies, or dragonflies. Disengagement trials consisted of either a beetle, butterfly, or dragonfly target among a matrix of spiders.

Control search trials included each possible variation of targets and distracters, other than those included in the engagement and disengagement trials. Target-absent trials were interspersed throughout the experiment to ensure that participants maintained careful responding.

Procedure

Each participant was tested individually. Participants were informed that the purpose of the study was to pilot new measures of cognitive processing. All further instructions, tasks, and questionnaires were presented via the computer using Inquisit 3.0 Desktop experimental software (2009).

Participants completed a demographic questionnaire and pre-test SUDS ratings before beginning the cognitive tasks. Subsequently, they completed the NSAT, which was followed by a mandatory two-minute break in the testing room and SUDS ratings. Participants then completed the VST, followed by a break, and SUDS ratings. Finally, participants completed all symptom questionnaires on the computer, in a completely randomized order. Stimulus ratings were completed last.

Results

Data Preparation

NSAT. To verify that participants in each condition successfully completed the manipulation, accuracy rates on the NSAT were examined. Frequency analyses indicated a bimodal distribution, wherein a small number of participants evidenced lower accuracy rates (< 78%). As such, all participants in the less accurate distribution were excluded (n = 4). The remaining 130 participants evidenced excellent accuracy rates (*mean* = 94.35%, *SD* = 4.87%, *range* = 79% – 100%).

VST. Following the exclusion of target absent trials, accuracy rates on the VST were examined. Similar to previous findings (Ouimet et al., 2012), a substantial portion of participants demonstrated poor accuracy across all trials of the VST (*mean* accuracy = 83.06%, *SD* = 6.99%, *Range* = 61% - 90%). Moreover, accuracy rates differed significantly according to trial type, $F(1.822, 234.982)$[3] = 71.61, $p < .001$. Participants were less accurate on spider-disengagement trials than on spider-engagement, $t(258) = -6.00$, and non-spider trials, $t(258) = -12.78$, and less accurate on engagement trials than on non-spider trials, $t(258) = -6.13$ (all p's < .001). Therefore, as in Ouimet et al. (2012), both accuracy and reaction time data were included as outcome variables. Reaction time data was calculated only for trials on which participants correctly identified whether an odd-one-out was present in the matrix.

To control for individual differences in speed and accuracy of responding, difference scores were calculated to obtain four bias indices: (1) Engagement speed (mean Engagement RT – mean Control RT), wherein positive scores reflect slowed, or reduced, engagement and negative scores reflect facilitated engagement; (2) Disengagement speed (mean Disengagement RT – mean Control RT), wherein positive scores reflect impaired disengagement, and negative scores reflect facilitated disengagement; (3) Engagement accuracy (Engagement accuracy – Control accuracy), wherein positive scores indicate higher accuracy and negative scores indicate lower accuracy), and (4) Disengagement accuracy, wherein positive scores indicate higher accuracy and negative scores indicate lower accuracy. Two Engagement speed index scores fell more than three standard deviations below the mean and one Disengagement

[3] This analysis resulted in a violation of Mauchley's Test of Sphericity, $\chi^2(2) = 13.20$, $p = .001$; therefore, Greenhouse-Geiser tests are reported ($\varepsilon = .91$).

speed index score fell more than three standard deviations above the mean; these participants were excluded, resulting in a final sample of 127 participants (64 RA, 63 NG). One sample t-tests indicated that all four indices were significantly different from 0 (absolute values of all $t > 4.37$, all $p < .001$).

Sample Characteristics

Descriptive data for all attention and symptom-related variables are displayed in Table 3. Analyses indicated that there were no significant differences on any variables of interest according to age, sex, handedness, level of education, or mother tongue. Skewness and kurtosis were within acceptable limits for all measures.

Attention Bias

Although our original hypotheses were related to reaction times only, results indicating variable accuracy suggest that this is likely an important variable to assess as well. As such, two separate analyses of variance (ANOVAs) were conducted to examine the effects of our experimental manipulation on engagement and disengagement speed and accuracy. A 2 x 2 (Condition [NG, RA] x accuracy bias index [Engagement accuracy, Disengagement accuracy]) mixed model ANOVA demonstrated a significant main effect of bias index, $F(1, 125) = 37.62$, $p < .001$, $\eta_p^2 = .23$. Specifically, participants evidenced greater engagement accuracy indices than disengagement accuracy indices. In other words, participants were more accurate when detecting spiders among homogenous distractors than when detecting bug targets among spider distractors. It is important to note, however, that both biases were negative, indicating that participants were most accurate for control trials, where no spiders were present. There was no main effect of

Table 3

Descriptive data for all attention- and mood-related variables

		Reappraise (n = 64)			Negate (n = 63)		
Variable	α	Mean *(SD)*	Min.	Max.	Mean *(SD)*	Min.	Max.
VST Accuracy (%)							
Spider-engagement	-	80.78 *(10.36)*	50.00	95.00	83.57 *(9.52)*	60.00	100.00
Spider-disengagement	-	75.39 *(11.96)*	40.00	95.00	75.48 *(10.91)*	50.00	95.00
Non-spider control	-	87.36 *(7.72)*	68.00	100.00	86.83 *(7.17)*	61.00	100.00
VST Reaction times (ms)	-	-	-	-	-	-	-
Spider-engagement	.66	2219.10 *(372.88)*	1553.69	3225.27	2259.65 *(377.68)*	1573.31	3510.31
Spider-disengagement	.72	2309.78 *(404.61)*	1600.64	3158.00	2354.48 *(408.96)*	1135.09	3254.93
Non-spider control	.85	2116.38 *(346.81)*	1516.55	2783.92	2173.05 *(361.86)*	1576.15	3311.38
VST Bias Indices	-	-	-	-	-	-	-
Engagement accuracy (%)	-	-6.58 *(9.35)*	-30.00	20.00	-3.26 *(9.70)*	-24.00	20.00
Disengagement accuracy (%)	-	-11.97 *(11.21)*	-44.00	15.00	-11.36 *(10.17)*	-32.00	18.00
Engagement speed (ms)	-	102.72 *(246.76)*	-438.58	673.64	86.60 *(243.19)*	-441.69	658.91
Disengagement speed (ms)	-	193.40 *(238.98)*	-407.36	802.35	181.43 *(272.85)*	-565.10	969.59
BAI	.89	10.98 *(9.26)*	0.00	40.00	12.76 *(8.35)*	1.00	36.00
BDI	.90	10.61 *(8.27)*	0.00	30.00	12.35 *(9.04)*	0.00	46.00
FSQ	.97	27.16 *(30.09)*	0.00	119.00	33.08 *(35.43)*	0.00	123.00

SPQ	.91	9.45 *(6.47)*	0.00	26.00	10.67 *(6.87)*	1.00	26.00
SUDS: Pre-test	-	17.00 *(21.94)*	0.00	80.00	19.59 *(24.56)*	0.00	80.00
SUDS: Post-NST	-	16.11 *(19.52)*	0.00	70.00	19.41 *(22.88)*	0.00	85.00
SUDS: Post-VST	-	15.77 *(19.65)*	0.00	75.00	19.90 *(22.35)*	0.00	90.00

VST = visual search task; BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; FSQ = Fear of Spiders Questionnaire; SPQ = Spider Phobia Questionnaire; SUDS = subjective units of distress scale, anxiety item.

condition, $F(1, 125) = 1.90$, $p = .17$, $\eta_p^2 = .02$, nor an interaction $F(1, 125) = 1.51$, $p = .22$, $\eta_p^2 = .01$ (see Figure 5).

A 2 x 2 (Condition [NG, RA] x RT bias index [Engagement speed, Disengagement speed]) mixed model ANOVA demonstrated a significant main effect of bias index, $F(1, 125) = 11.99$, $p = .001$, $\eta_p^2 = .09$. Specifically, participants evidenced greater disengagement biases (i.e., slower RTs compared to controls) compared to engagement biases. It is important to note, however, that across conditions, participants demonstrated positive values for both bias indices, indicating a tendency to be slower on all trials where a spider was present (either as a target or a distractor). There was no significant main effect of condition, $F(1, 125) = 0.16$, $p = .69$, $\eta_p^2 = .001$, or interaction, $F(1, 125) = 0.006$, $p = .94$, $\eta_p^2 < .001$ (see Figure 5).

Symptom measures

Subjective mood data (SUDS) were collected at three time points for distress, sleepiness, happiness, and frustration, the latter three of which were assessed purely as filler questions. A 2 x 3 (Condition [NG, RA] x Time point [pre-test, post-NSAT, and post-VST]) mixed model ANOVA was conducted to examine changes in subjective distress. Results demonstrated a violation of Mauchly's Test of Sphericity, $\chi^2(2) = 67.12$, $p < .001$; therefore Greenhouse-Geiser tests are reported ($\varepsilon = .71$) for the effects of time point. No significant main effect of condition, $F(1, 125) = .90$, $p = .35$, $\eta_p^2 = .01$, or time point emerged, $F(1.41, 176.30) = .08$, $p = .85$, $\eta_p^2 = .001$, nor was there a significant interaction, $F(1.41, 176.30) = .15$, $p = .78$, $\eta_p^2 = .002$.

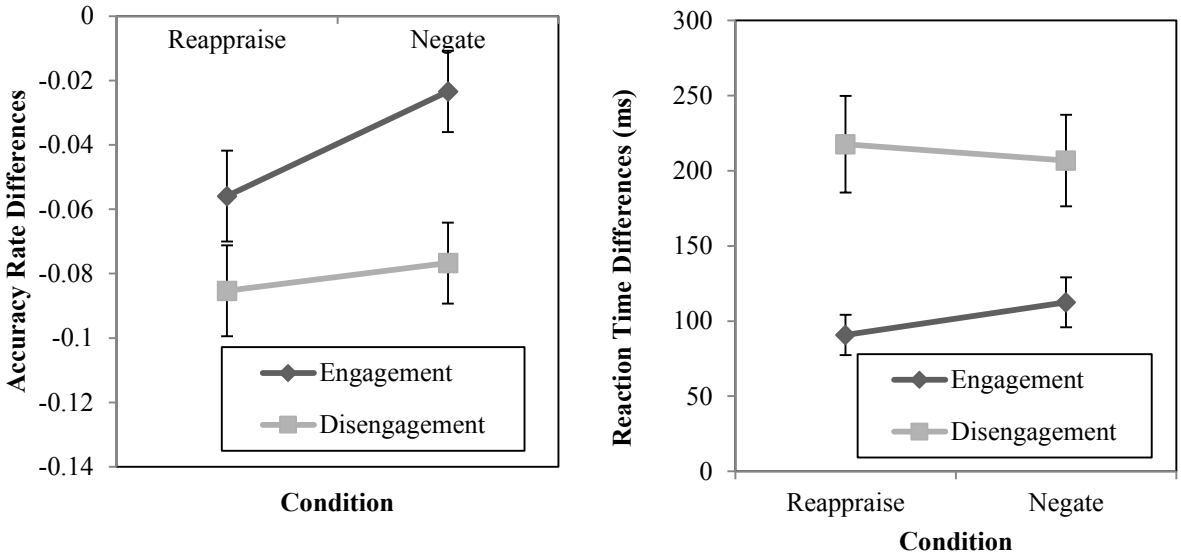


Figure 5. Accuracy and reaction time Bias Indices on the Visual Search Task by condition. Error bars represent standard errors. * $p < .001$.

Because the FSQ and SPQ are highly correlated and are assumed to measure similar constructs, a multivariate ANOVA was conducted to examine the effects of the manipulation on self-reported spider fear and avoidance. Results demonstrated no significant difference in scores as a function of condition, $F(2, 124) = .57$, $p = .57$, $\eta_p^2 = .009$. Two separate t-tests were conducted to examine whether our manipulation also affected other reports of mood and anxiety symptoms (BAI and BDI), thereby potentially reflecting an overall increase in negative affect. No significant differences emerged between conditions for the BAI, $t(125) = -1.14$, $p = .26$, or BDI, $t(125) = -1.13$, $p = .26$.

Exploratory Analyses

Correlations. To examine whether there was any relationship between the proposed mediator (attention bias) and subjective mood measures, a series of correlations was conducted. None of the four attention bias indices showed a significant relationship with self-report measures of spider fear and avoidance (FSQ, SPQ) or state distress (SUDS). However, Engagement accuracy was significantly correlated with BDI scores, $r = -.27$, $p = .003$, such that greater spider engagement accuracy was related to reduced depression severity. Moreover, Disengagement speed was significantly correlated with BAI scores, $r = .19$, $p = .03$, such that slower disengagement from spiders was related to increased anxiety severity. Given these findings, the ANOVAS described above were re-conducted with BAI and BDI scores entered as covariates; no change in results emerged.

Multiple Mediation Analyses

In contrast with previous literature comparing reaction times for different trial types, data from the current study evidenced significant variability in accuracy. As such, the extent to which observed reaction times represented a “pure” measure of attentional

disengagement was questionable. Therefore, to assess the main hypothesis, that repeated negation of spider-fear associations would predict impaired (slowed) disengagement, which would subsequently predict higher levels of reported spider fear, participants who were correct on fewer than 66.66%[4] of trials on any single trial type were excluded (n = 35). This exclusion and subsequent analyses were conducted in an exploratory fashion to attempt to strike an appropriate balance between obtaining the most "pure" measure of disengagement speed possible and retaining adequate power to observe any significant findings (exploratory n = 92, RA = 46, NG = 46).

A multiple mediation model was conducted, using bootstrapping methods with 5,000 samples, 95% confidence intervals, bias corrected and accelerated (INDIRECT Macro for SPSS Statistics, version 20.0; Preacher & Hayes, 2008). Condition was entered as the independent variable, reaction time attention bias indices were entered as potential mediators (Engagement speed, Disengagement speed), and a composite spider fear variable obtained by taking the mean of standardized FSQ and SPQ scores was entered as the criterion variable.

Condition did not emerge as a significant predictor of either potential mediator. Moreover, neither of the potential mediators was a significant predictor of the spider fear composite. Scores on the spider fear composite were significantly predicted by condition (unstandardized b = .46, SE = .19, t = 2.36, p = .020), wherein higher scores were

[4] Because there was no precedent in the literature, an arbitrary value was chosen. Using a more inclusive cutoff point of 50% accuracy would mean including many participants who performed only at chance level (responses on the VST were either "yes" or "no"), thereby including a large amount of error. Using a more stringent cutoff point of 75% accuracy reduced our sample size to approximately 20 participants per condition, dramatically reducing experimental power. As such, 66.66% (or two thirds) accuracy was chosen to balance between these two limitations.

predicted by assignment to the NG condition. After accounting for effects of the potential mediators, the relationship between condition and reported spider fear remained largely unchanged (unstandardized $b = .45$, $SE = .19$, $t = 2.31$, $p = .023$). Percentile confidence intervals (CIs) provided no evidence of mediation. Overall, there was a trend for the model to account for a small, but significant amount of variance in scores on the spider fear composite, $R^2 = .076$, $F(3, 88) = 2.39$, $p = .07$, providing some limited support for the hypothesis that repeated negation, compared to repeated appraisal, may impact upon symptom reporting.

Discussion

The current study was designed as a preliminary test of the hypothesis that maladaptive rule-based processing contributes to threat-relevant attention bias, which subsequently predicts increased reported anxious psychopathology. Specifically, I investigated whether participants who repeatedly negated spider-fear associations would evidence impaired disengagement from spiders and subsequently, greater reported spider fear compared to participants who repeatedly reappraised spiders as safe or neutral. Results did not support hypotheses; however, several methodological limitations are noted below. The main significant finding that emerged was consistent with previous literature, in that participants were faster and more accurate when detecting spiders among homogeneous distractors than they were when detecting other bugs among an array of spiders.

Interestingly, correlational relationships were observed between certain components of attention bias and more broad-based measures of psychopathology. Specifically, greater engagement accuracy was related to decreased depressive severity

on the BDI, and impaired disengagement was associated with greater anxiety severity on the BAI. These relationships were unaffected by condition. Although the relationship between anxiety and impaired disengagement is consistent with previous research, it is surprising, considering the observed lack of relationship between disengagement speed and spider fear/avoidance. It may be that individuals who tended to experience higher levels of anxiety had greater difficulty disengaging from threat, but were not spider fearful, *per se*. Moreover, because concentration can be impaired by symptoms of depression, it may be that individuals with decreased severity (or complete absence) of depression were better able to detect spiders among arrays of other bugs.

Post-hoc exploratory analyses were conducted within a subsample selected for reasonable VST accuracy to account for some of the methodological limitations. Results within this subsample were partially consistent with hypotheses. Compared to repeated reappraisal, repeated negation resulted in higher levels of self-reported spider fear and avoidance. In contrast with previous research, attentional responding was unrelated to reported spider fear. Moreover, no evidence for mediation of the relationship between rule-based processing and spider fear by disengagement was observed.

As discussed elsewhere (Ouimet et al., 2012), these findings may be related to the nature of the VST. Specifically, the VST may not provide a "pure" assessment of engagement or disengagement processes, but likely reflects a combination of cognitive processes including attention shifting, visual scanning, and cognitive speed. Moreover, observed low accuracy rates in the current study complicate measurement of reaction time. Indeed, reaction times in the current study were relatively long in comparison to most research investigating attention bias, suggesting more complex processing. For

example, detecting a dragonfly among a matrix of spiders may reflect both repeated facilitated engagement with spider distractors as well as difficulty disengaging from such stimuli. Future research in this area may benefit from the use of paradigms that more clearly differentiate among cognitive processes.

It is particularly important to note that I used a nonclinical sample. Although I endeavoured to measure (and influence) attention bias among participants with a broad range of spider fear, research has demonstrated that attention biases are often not observed among non-anxious samples (e.g., Bar-Haim et al., 2007; Cisler & Olatunji, 2010). As such, it is possible that the current sample was not fearful enough to detect differences in attention bias. However, non-anxious control groups often consist of participants selected for particularly low levels of fear, rather than individuals with normative levels of fear (e.g., Teachman, 2007). Moreover, with respect to specific phobias, although biases for spider stimuli tend to be more pronounced in spider fearful samples (e.g., Lipp & Derakshan, 2005; Osinsky et al., 2008), attention biases for phylogenetically prepared fear-relevant stimuli such as spiders, snakes, and angry faces are typical of nonselected populations (see Ohman & Mineka, 2001, for a review) Finally, a recent meta-analysis demonstrated no significant difference in attention bias effect sizes between clinically diagnosed anxiety populations and populations of non-clinical participants with high levels of self-reported anxiety (Bar-Haim et al.), suggesting that although a clinical sample may provide the greatest likelihood of observing attentional biases, a broad range of spider fear is useful for understanding individual differences in cognitive processing. Given the largely null findings of the

current study, however, future research examining the effects of negation and reappraisal on attention bias within a highly fearful sample is warranted.

Indeed, the use of a non-clinical versus clinical sample may be particularly important considering previous research conducted using the NSAT. In a series of two studies, Gawronski et al. (2008) demonstrated that, compared to negation of stereotypic attitudes, affirmation of gender and race counterstereotypes (i.e., women-strong/men-weak and Black-positive/White-negative) resulted in reduced activation of gender stereotypes and reduced automatic preference for Whites over Blacks, respectively. The original stereotypes that this training task was purported to activate/deactivate, however, have been demonstrated to occur robustly within the general population (Greenwald & Banaji, 1995). For example, in a very large scale review compiling the results of over 2.5 million IATs completed online, almost 70% of participants demonstrated stronger Black/dark skin-bad and White/light skin-good associations than for the reverse pairings (d = 0.77; Nosek et al., 2007). As such, the automatic attitudes and evaluations assessed by Gawronski et al. may have been more highly prevalent in their student sample than were the automatic spider-danger associations within the current study. For example, a sample of high spider fearful participants who completed the GNAT evidenced a mean GNAT D score (conceptually similar to Cohen's d) of .26, which was significantly higher than scores obtained by a low spider fearful sample (GNAT D = -.03; Teachman, 2007). If indeed spider-fear (and butterfly-calm) associations are smaller in magnitude (or in prevalence) than gender or race stereotypes, it is possible that the spider NSAT used in the current study was less effective at activating/deactivating such associations, thereby reducing the likelihood that effects of the manipulation on attention bias and/or spider

fear would be observed. In other words, associations can only be ironically activated through repeated negation to the extent that they are present and strong. As such, the NSAT as it was designed for the current study may be of use only within a clinical sample.

The exploratory finding that repeated reappraisal led to lower levels of spider fear than did repeated negation is consistent with the core tenet of cognitive theory: that cognition leads to affect (Beck, 1967). Moreover, research on interpretive bias has consistently demonstrated a tendency to appraise ambiguous stimuli negatively (e.g., Salemink et al., 2010). The use of the NSAT in the current study may have provided important information about not only the *nature* of appraisal biases, but also the *process* by which they may develop or be maintained. It is possible that repeated negation (e.g., that spider is *not* dangerous) results in ironic endorsement of symptoms of psychopathology, compared to repeated "safe" reappraisal (albeit, with small effect sizes). This finding may partially explain research by Teachman and Addison (2008), which demonstrated that presumed "positive" training (e.g., the spider is harmless) was only partially effective at reducing symptoms of spider fear. The methodology employed by such training paradigms may activate and strengthen the relationship between concepts associated with harm and the stimulus at hand (Gawronski et al., 2008). What remains unclear from results of the current study is whether greater reported fear within the more accurate subsample of participants was a direct result of activated spider-fear associations, as suggested by the multi-process model of cognitive vulnerability to anxiety (Ouimet et al., 2009). Future research that incorporates manipulation of rule-based processing with pre- and post-manipulation measures of associative processing will

be integral to furthering our understanding of the interaction between these two systems. Moreover, because this finding emerged only within a severely limited sample, it would be particularly important to investigate whether it could be replicated with more appropriate tasks.

Despite the preliminary nature of this study, the results may have interesting clinical implications. Currently, cognitive-behaviour therapy (CBT) is the treatment of choice for anxiety disorders (Chambless & Ollendick, 2001; DiMauro, Domingues, Fernandez, & Tolin, 2013; S. G. Hofmann & Smits, 2008; Norton & Price, 2007; Stewart & Chambless, 2009; Tolin, 2010). My findings, however, suggest that it may be useful to pay attention to the language used during cognitive restructuring about the dangerousness of feared stimuli or situations. Specifically, although encouraging clients to evaluate spiders, social situations, or contaminated objects as "not dangerous" or "harmless" may lead to more adaptive reported beliefs, it may also serve to strengthen memorial links between such stimuli and fear-related concepts. This discrepancy between 'explicit' beliefs and 'implicit' associations may explain clinical observations of clients who believe a stimulus (e.g., snake) to be safe but still exhibit terror and avoidance upon its exposure. As such, it may be more clinically effective to foster the reappraisal of feared stimuli as safe or relatively neutral, thereby potentially weakening associative links and increasing the correspondence between implicit and explicit attitudes.

CHAPTER 5:

GENERAL DISCUSSION

This project of research was designed to assess the usefulness of integrating dual-systems accounts of cognitive functioning, developed within the social-cognitive literature, with cognitive theories of vulnerability to anxiety. In particular, I investigated the extent to which individual differences in information processing within the associative and rule-based systems could clarify discrepant findings in research related to attentional bias in spider fear. Because of the novel use of such models within the realm of clinical psychology (see Teachman, Cody, & Clerkin, 2010), these two studies represented preliminary tests of a multi-process model of cognitive vulnerability to anxiety (Ouimet et al., 2009), and assessed separately the influences of spider-fear association strength and rule-based (in)validation (reappraisal vs. negation) on attention bias and reported spider fear. Particularly important to the theoretical model, attention bias was measured both in terms of engagement with and disengagement from spiders, allowing for a better understanding of the stages of attention that may be influenced differentially by dual-systems processing.

Summary of Findings

Study 1. In this study, unselected undergraduate participants completed measures of strength of spider-fear associations (compared to spider-calm associations), attentional engagement with and disengagement from spiders (in terms of both accuracy and speed), and overt reports of spider fear and avoidance. Although previous research has investigated relationships among some of these variables (Teachman, 2007; Van Bockstaele et al., 2011a, 2011b), this study was designed specifically to test the

hypothesis that stronger spider-fear associations would predict impaired disengagement from spider stimuli, which would subsequently predict elevated levels of spider fear.

Results were partially consistent with hypotheses. In contrast with prior research, participants evidenced significant differences in accuracy across attention measures. Specifically, participants were least accurate on trials where they were required to disengage from 15 spiders to find a 'bug' target, and most accurate on trials where they were required to find a spider among 15 homogenous 'bug' distractors. Participants were also slowest on disengagement trials and fastest on engagement trials. Moreover, correlations demonstrated that stronger spider-fear associations were associated with reduced disengagement accuracy, and higher reported spider fear was associated with faster performance on both engagement and disengagement trials.

With respect to the main hypothesis of interest, an indirect relationship between stronger spider-fear associative links and higher levels of reported spider fear emerged via reduced disengagement accuracy only. Thus, although disengagement speed was unrelated to the relationship between 'implicit' and 'explicit' spider fear, disengagement *accuracy* proved important. To my knowledge, this is the first study to show that individual differences in associative processing can predict cognitive bias and subsequent reported anxiety. Moreover, the results highlight the importance of using methodologies which assess separately (but within the same study) the multiple components of attention, including orientation, engagement, disengagement, speed, and accuracy.

It is important to note that as is typical of studies assessing attention, effect sizes within study 1 were modest. This finding likely reflects first, the subtlety of effects that are observed when using accuracy and reaction time data, and second, that mental health

problems are rarely, if ever, caused by a single factor. Study 2 was designed to investigate the influence of rule-based processing on attention bias and subsequent reported spider fear.

Study 2. For this study, participants were randomly assigned into either the reappraise (RA) or negate (NG) conditions, wherein they repeatedly reappraised spiders as calm-related or repeatedly negated the anxiety-relevance of spiders, respectively. Subsequently, they completed computerized measures of attentional engagement and disengagement, as well as questionnaires assessing their level of spider fear. Again, reduced accuracy on the VST was noted. Overall, participants were slower on disengagement trials than on engagement trials. This effect, however, was not moderated by condition. Indeed, there was no main effect of condition on either attention bias or reported spider fear. Moreover, attentional responding was unrelated to reported spider fear. Because of the variability of accuracy rates on the VST, exploratory analyses were conducted for a subsample of participants who evidenced reasonable error rates on this task. Within this subsample, bootstrapped multiple mediation analyses demonstrated that greater levels of spider fear and avoidance were predicted by assignment to the NG condition (in contrast to the RA condition), providing some support for the hypothesis that repeated negation may result in ironic increases in fear. Contrary to hypotheses, the relationship between condition and reported spider fear was not mediated by attention bias.

Theoretical Implications

The multi-systems model of vulnerability to anxiety disorders (Ouimet et al., 2009) tested in the current studies represents an attempt to explain not only divergent

findings related to threat-relevant attention bias, but also common clinical experiences whereby the explicit beliefs of treatment-seeking clients are inconsistent with their behaviour and affective reactions. Spider fearful individuals may explain that they "know" the spider in the cage on their therapist's desk cannot harm them, but that they still "feel" terrified that it may somehow escape and kill them. Similarly, although people with generalized anxiety disorder may acknowledge that the likelihood of their plane crashing is infinitesimally low[5], the lack of 100% certainty of surviving the flight results in family vacations only to destinations within driving distance. Indeed, the distinctions between two processing systems (automatic vs. controlled, implicit vs. explicit, knowing vs. feeling, etc.), and their effects on pathological behaviour have received considerable attention in recent years. As emphasized by Roefs et al. (2011), measurement of implicit constructs are useful only to the extent that they provide information beyond that of self-report instruments. The current studies provide some support for the incremental usefulness of such measurement in understanding attention bias and vulnerability to anxiety.

The findings from Study 1, that strong spider-fear associations predicted elevated levels of self-reported spider fear/avoidance, and moreover, that this was an indirect relationship via reduced disengagement accuracy has several implications. The magnitude of the relationship between associative strength and spider fear was modest (.15 - .20). Although this finding at first glance may appear to disconfirm the construct

[5] According to the *OAG Aviation and PlaneCrashInfo.com Accident Database* (20 years of data, 1993-2012), the likelihood of being killed on a single airline flight administered through 1 of the 78 major airlines is 1 in 4.7 million (or .0000213%). This likelihood drops considerably, to 1 in 19.8 million (or .00000505%), when considering the 39 world airlines with the best accident rates.

validity of the GNAT, it is consistent with a large body of research demonstrating that indirect and direct measures of a particular construct provide distinct but related outcomes (Nosek & Smyth, 2007). Indeed, a recent review reported that correlations between indirect and direct measures of specific phobia fall within a wide range (-.21 - .67), with studies using more theoretically relevant constructs (i.e., spider-danger vs. spider-negative) and reduced method invariance (i.e., measuring spider-danger on both measures) evidencing the strongest effects (Roefs et al., 2011). Results from Study 1, therefore, extend extant research by providing support for the contention that other cognitive processes may mediate (and potentially moderate, though not tested here) the relationship between 'implicit' and 'explicit' beliefs. Indeed, the extent to which individuals were able to accurately disengage from spider pictures accounted for much of the variance in the relationship between spider-fear associations and reported spider fear/avoidance. Moreover, the differential relationships between attention bias and direct and indirect measures of fear lend further support to the contention that measurement of both types of beliefs is important to understanding the development and maintenance of anxious pathology.

Although associative strength was not measured in Study 2, both studies assessed the relationship between self-reported spider fear and attentional responding on the VST. In Study 1, results were surprising; higher self-reported spider fear was related to faster engagement and disengagement. In Study 2, no relationship between attention bias and spider fear was observed. For both studies, results are inconsistent with previous research. As discussed in Chapters 2 and 4, the VST may not measure attention bias, *per se*. Although the VST was chosen because of its potential to assess individual differences

in time-course of responding to threat rather than group differences at arbitrarily chosen presentation durations, it may instead measure efficient and uncontrollable processing of threat-relevant material (Teachman, Joormann, Steinman, & Gotlib, 2012), two of four separable components (unconsciousness, efficiency, unintentionality, uncontrollability) believed to contribute to automaticity (Bargh, 1994). To the extent that an individual accurately and quickly detects a spider among neutral distractors (i.e., engagement trial), processing of threat is efficient; to the extent that an individual struggles to detect a neutral target (e.g., dragonfly) among spider distractors (i.e., disengagement trial), processing of threat is uncontrollable or unstoppable, regardless of intention (McNally, 1995; Moors & De Houwer, 2006; Teachman et al., 2012). As such, although the engagement and disengagement trials of the current study were designed to measure different phases of a presumed continuous attentional process, they may actually have measured separable automatic processing characteristics, which do not always co-vary (Moors & De Houwer, 2006).

These studies highlighted the importance of considering the complexity of cognitive processes, particularly when assessing biases. According to Ouimet et al. (2009), the phases of attention are characterized by different components of automaticity/strategy. Specifically, orientation may be unconscious and unintentional, but not capacity-free/efficient; engagement may be conscious and controllable, but unintentional and inefficient; and avoidance may be conscious, intentional, controllable, and inefficient[6]. Disengagement, rather than a conceptually distinct stage of attention, is

[6] Although these characteristics combined suggest that avoidance is almost a completely strategic decision, it is also possible to develop a more "automatic" avoid behavioural schema, which would be linked to the stimulus in the associative system.

considered the result of the interplay between the behavioural schemata activated through the associative system and the behavioural decision(s) provided by the rule-based system. Impaired disengagement, therefore, is posited to occur when the responses of these systems conflict. In considering a disengagement trial on the current version of the VST, an individual searching for a neutral odd-one-out will fixate on one stimulus at the time, with the goal of deciding whether it is the target. With each fixation, inputs from the associative and rule-based systems are believed to impact how quickly and/or accurately an individual is able to move from one stimulus to the next. If, however, as contended by Teachman et al. (2012), such a trial is a measure of (un)controllability more than attention, *per se*, the current studies may have provided a good test of relationships between different characteristics of automaticity/strategy, but not necessarily attentional engagement and disengagement. Future research should endeavour to measure specific aspects of cognition (e.g., associative strength) while capturing attentional processes in the most ecologically valid way possible.

Indeed, information processing models of attention in anxiety posit that highly anxious individuals actually avoid threatening stimuli at later stages of attention (e.g., Koster et al., 2007; Mogg & Bradley, 2004; Rinck & Becker, 2006). The multi-systems model proposes that attentional avoidance is considered the result of adaptive rule-based processes, whereby the stimuli are reappraised as safe, disengagement occurs, and anxiety (if triggered initially) dissipates (Ouimet et al., 2009). Support for this model, therefore, would come from earlier and sustained attentional disengagement and avoidance of threatening stimuli by less anxious participants, which is counterintuitive from a cognitive perspective. Indeed, most cognitive models of anxiety contend that

avoidance of threat functions as a safety-seeking behaviour that perpetuates faulty beliefs about the stimulus itself, the individual's ability to cope, and the processes by which anxiety attenuates (see Helbig-Lang & Petermann, 2010, for a recent discussion).

It is important, however, to distinguish between attentional and behavioural avoidance. Cognitive models generally focus on behavioural avoidance, whereas information processing research typically measures attentional avoidance. Although attentional allocation is certainly a behaviour in its own right, it differs conceptually from behavioural avoidance, such as leaving a room where a spider is present, using complex driving routes to avoid bridges, or going to parties only in the company of one's significant other. Indeed, attentional *engagement* and behavioural *avoidance* may at times serve the same purpose. For example, a spider phobic individual who notices a spider in the room will likely maintain his/her focus (i.e., attentional engagement) on the spider to ensure that it doesn't move closer, thereby guaranteeing safety; similarly, (s)he may escape the room (i.e., behavioural avoidance) to achieve the same result. Attention bias studies typically measure the extent to which individuals engage, disengage, or avoid static images on a computer screen. Eventual avoidance of such images (as posited by vigilance-avoidance models), which may elicit anxiety but cannot possibly attack the participant, likely results in attenuation of anxiety, whereas attentional avoidance of actual spiders in the environment likely increases anxiety. Findings from the current studies are consistent with previous research, in that participants were slower to disengage from spiders than they were to detect spiders. Interestingly, in Study 1, individuals with higher self-reported spider fear actually disengaged more quickly from spiders. In other words, they exhibited earlier attentional avoidance. In fact, this finding

may be consistent with vigilance-avoidance models, in that they detected the spiders in the array more quickly, thereby initiating the "avoid" sequence earlier, and ultimately demonstrating shorter reaction times. It is important to consider the possibility that information processing research may not accurately capture the processes that occur in the presence of real, rather than simulated threat.

As such, research designed to assess attention bias to real spiders may provide a more ecologically valid observation of such processes. However, as pointed out by Rinck, Kwakkenbos, Dotsch, Wigboldus, & Becker (2010), it is impossible to standardize spider activity, which leads to a particularly important confound. In response to this limitation, Rinck et al. measured attention, approach, and avoidance of dirt spots and moving and non-moving spiders in an immersed virtual art museum. Compared to non-fearful participants, spider fearful participants kept the virtual spiders in view for longer periods of time (attentional engagement), while maintaining a greater physical distance from them (behavioural avoidance) (Rinck et al., 2010). This study supports the contention that behavioural avoidance is characteristic of anxiety, but contradicts previous findings related to attentional avoidance. It seems instead that spider fearful individuals will remain engaged with spiders that move or threaten to move, likely to ensure continued safety. This finding highlights the importance of constructing ecologically valid observational and experimental paradigms to assess for cognitive bias. Although the current studies endeavoured to utilize highly threatening pictures, the model they were designed to test may necessitate experimental paradigms that more closely mimic real-life conditions.

Clinical Implications

Although the findings from the current program of research were modest, they present some interesting ideas for potentially improving upon extant efficacious psychological treatments for anxiety disorders, such as cognitive behavioural therapy (CBT). Several reviews and meta-analyses have confirmed the efficacy and effectiveness of CBT for anxiety disorders (Butler, Chapman, Forman, & Beck, 2006; Norton & Price, 2007; Stewart & Chambless, 2009; Tolin, 2010); however, a portion of patients either remain unwell or relapse following treatment. To better understand how CBT contributes to symptom change (and, consequently, why it is less effective for some participants), researchers have begun to focus on mechanisms of change, particularly those related to cognitive bias (e.g., Kraemer, Wilson, Fairburn, & Agras, 2002; Rapee, Gaston, & Abbott, 2009; Teachman, Marker, & Clerkin, 2010).

The findings from the current studies suggest that cognitive biases at multiple levels likely impact upon affective and behavioural symptoms. Moreover, it appears that different facets of attention bias, namely accuracy and speed, are distinctly related to indirect (i.e., associative) and direct (i.e., self-report) measures of spider fear. Together with findings from extant research which demonstrate that 'implicit' and 'explicit' fear make distinct contributions to behavioural avoidance, physiological fear responses, and anxiety symptoms (see Roefs et al., 2011, for a review), results from the current program of research suggest that therapeutic interventions which target overt beliefs as well as fear-relevant associative processes may provide even better outcomes. Indeed, the indirect relationship observed in Study 1 suggests that symptom improvement could potentially be achieved either by weakening spider-fear associations or by improving disengagement accuracy.

Whereas a growing, yet controversial, body of research supports the efficacy of cognitive bias modification (CBM) in the treatment of anxiety disorders (see Beard, 2011; Hallion & Ruscio, 2011), research aimed at modifying clinically relevant associations is limited and has provided mixed results (e.g., Amir, Kuckertz, & Najmi, 2012; Clerkin & Teachman, 2010; Green & Teachman, 2012; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). Although Study 2 did not measure change in associative strength directly, it was designed to activate extant spider-fear associations (in the NG condition only). This manipulation, however, had no effect on attention, and exerted small effects on spider fear/avoidance only within a severely restricted subsample of participants. Whereas these findings, in tandem with other studies that have produced null results (Teachman, Marker, & Smith-Janik, 2008) may indicate that activating/modifying such associations is difficult and/or has limited effects on clinical correlates, it is also important to remember that such paradigms are novel within psychopathological research. As such, continued research into methodologies that effectively measure such processes may also lead to increased ability to modify them, with the goal of decreasing symptoms.

Finally, fear-relevant associations can likely be modified without the use of experimental paradigms designed for this purpose. Indeed, one of the goals of cognitive therapy for anxiety is to alter maladaptive schemata, which broadly speaking comprise a series of interconnected fear-relevant associations (Dobson & Dobson, 2009; Foa, Huppert, & Cahill, 2006; Lang, Bradley, & Cuthbert, 1998). Particularly relevant to the current program of research are two recent studies which demonstrated changes in fear associations following CBT for individuals with GAD (Reinecke, Rinck, Becker, &

Hoyer, 2013) and panic disorder (Teachman et al., 2008). Moreover, both studies showed evidence for fear associations to predict trajectories of change. Among individuals receiving CBT for panic disorder, change in self-panic associations predicted subsequent change in panic symptom severity; however, the reverse relationship was not observed (Teachman et al., 2008). Among individuals receiving CBT for GAD, stronger associative biases were linked with delayed response to treatment and reduced change in intrusive thoughts compared to those with weaker associative biases (Reinecke et al., 2013). Both CBT protocols included elements of psychoeducation, relaxation training, cognitive restructuring, and exposure. What remains unclear from these studies is *what* effected change in associations and *how* this was accomplished. It may be that exposure weakened associations between the self- and panicky in panic clients (neutral worry-negative in GAD clients), and created/strengthened associations between self- and calm (neutral worry-positive). Alternatively (or additionally) sustained change in overt beliefs via cognitive restructuring may have resulted in "automatized" associations between physiological sensations (or worry domains) and insignificance. Moreover, it may be that certain individuals achieve such changes via distinct therapeutic interventions. Future research which examines what components of therapy produce changes in which cognitive biases may enable the refinement of existing effective therapies to adequately target the maintaining mechanisms for each individual, and ultimately provide enhanced care in the treatment of anxiety disorders.

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Appendix A

Consent Form (Identical for both studies)

CONSENT TO PARTICIPATE IN RESEARCH

This is to state that I agree to participate in a program of research being conducted by Allison J. Ouimet under the supervision of Dr. Adam S. Radomsky of the Fear and Anxiety Disorders Laboratory in the Psychology Department of Concordia University, whom I can contact:

By phone: 514-848-2424 ext.5965
By email: aj_ouime@live.concordia.ca

A. PURPOSE

I have been informed that the purpose of the research is to test new measures of basic thinking processes in order to better understand how the brain understands information.

B. PROCEDURES

I am aware that all parts of this experiment will take place right here in the lab. I will be asked to complete a series of questionnaires on the computer, complete some computer tasks involving pressing a button in response to images presented on the screen, and undergo a brief test of general memory. I will be given breaks in between trials to rest my eyes, and the entire study should take approximately 60 minutes.

C. RISKS AND BENEFITS

I understand that there are no major risks associated with this study, although there is the possibility of minor mental fatigue and eyestrain occurring while performing the computer tasks. I will be compensated for my time with one (1) participant pool credits, or one (1) entry into the annual cash prize draw.

D. CONDITIONS OF PARTICIPATION

I understand that I am free to withdraw my consent and discontinue my participation at anytime without negative consequences.

I understand that my participation in this study is confidential (i.e., the researcher will know, but will not disclose my identity).

I understand that the data from this study may be published.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND VOLUNTARILY AGREE TO PARTICIPATE IN THIS STUDY.

NAME (please print)_____

_____
SIGNATURE

Appendix B

Computerized GNAT Instructions (Study 1)

Afraid Only Trials:

In the following section you will see a black screen with the word AFRAID in the top right corner. Your task is to press the SPACEBAR when a word that fits into the category of AFRAID appears, and to press NOTHING if any other words or images appear. If you answer correctly, a green O will replace the item in the centre of the screen, if you answer incorrectly, a red X will appear. The next trial begins immediately after the O or X disappears, so please stay alert! You must answer as QUICKLY as possible while maintaining good ACCURACY. When you are ready to continue please press the ENTER key. Good luck, and have fun!

Spider Only Trials:

In the following section you will see a black screen with the word SPIDER in the top left corner. Your task is to press the SPACEBAR when an image of a SPIDER appears, and to press NOTHING if any other words or images appear. If you answer correctly, a green O will replace the item in the centre of the screen, if you answer incorrectly, a red X will appear. The next trial begins immediately after the O or X disappears, so please stay alert! You must answer as QUICKLY as possible while maintaining good ACCURACY. When you are ready to continue please press the ENTER key. Good luck, and have fun!

Calm Only Trials:

In the following section you will see a black screen with the word CALM in the top right corner. Your task is to press the SPACEBAR when a word that fits into the category of CALM appears, and to press NOTHING if any other words or images appear. If you answer correctly, a green O will replace the item in the centre of the screen, if you answer incorrectly, a red X will appear. The next trial begins immediately after the O or X disappears, so please stay alert. You must answer as QUICKLY as possible while maintaining good ACCURACY. When you are ready to continue please press the ENTER key. Good luck, and have fun!

Spider + Calm Critical Trials:

In the following section you will see a black screen with the word SPIDER in the top left corner and the word CALM in the top right corner. Your task is to press the SPACEBAR when EITHER a WORD that fits into the category of CALM appears OR a picture of a SPIDER appears, and to press NOTHING if any other words or images appear. If you answer correctly, a green O will replace the object in the centre of the screen, if you answer incorrectly, a red X will appear. The next trial begins immediately after the O or X disappears, so please stay alert! You must answer as QUICKLY as possible while

maintaining good ACCURACY. When you are ready to continue please press the ENTER key. Good luck, and have fun!

Spider + Afraid Critical Trials:

In the following section you will see a black screen with the word SPIDER in the top left corner and the word AFRAID in the top right corner. Your task is to press the SPACEBAR when EITHER a WORD that fits into the category of AFRAID appears OR a picture of a SPIDER appears, and to press NOTHING if any other words or images appear. If you answer correctly, a green O will replace the item in the centre of the screen, if you answer incorrectly, a red X will appear. The next trial begins immediately after the O or X disappears, so please stay alert. You must answer as QUICKLY as possible while maintaining good ACCURACY. When you are ready to continue please press the ENTER key. Good luck, and have fun!

Appendix C

Computerized VST Instructions (Studies 1 and 2)

Practice Trials:

Welcome to the Visual Search Task! This task may remind you of a game you played as a child: One of these things just doesn't belong here!

In this section, you will see a matrix of 16 animal pictures on each trial. There are four different categories of animals: BEETLES, BUTTERFLIES, DRAGONFLIES, and SPIDERS.

On some trials, all of the animals will come from the same animal category. On others, you may see an ODD-ONE-OUT.

In other words, there may be one picture (e.g., BEETLE) that belongs to a different animal category than the other 15 pictures (e.g., BUTTERFLIES). Your job is to press the "YES" key if there is an ODD-ONE-OUT and to press the "NO" key if all of the pictures come from the same category (e.g., all dragonflies).

If you answer correctly, a green O will appear in the centre of the screen. If you answer incorrectly, OR if you don't answer before the time limit, a red X will appear. The next trial begins immediately after the O or X disappears, so please stay alert!

It is very important to answer as QUICKLY as possible while maintaining good ACCURACY. When you are ready press the ENTER key to practice. Good luck, and have fun!

Post Practice:

Great job! You will now start the "test" portion of this task. If you have any questions about the task, please ask the experimenter now.

Again, your job is to press the "YES" key if there is an ODD-ONE-OUT and to press the "NO" key if all of the pictures come from the same animal category.

If you answer correctly, a green O will appear in the centre of the screen. if you answer incorrectly, OR if you don't answer before the time limit, a red X will appear. The next trial begins immediately after the O or X disappears, so please stay alert!

It is very important to answer as QUICKLY as possible while maintaining good ACCURACY. When you are ready press the ENTER key to begin. Good luck, and have fun!

Appendix D

Word List for GNAT* and NSAT

CALM	**AFRAID**
Calm	Afraid
Tranquil	Fear
Peaceful	Terror
Serene	Worry
Composed	Nervous
Safe	Anxious
Relaxed	Tense
Harmonious	Scared
Rest	Panic
Soothed	Alarmed
Collected	Dread
Gentle	Horror
Quiet	Uneasy
Comfort	Shock
Cool	Frightened
Settled	Distress
Docile	Petrified
Together	Disturbed
Secure	Shaky
Relieved	Spooked
Average # of characters = 6.5	*Average # of characters = 6.4*
Average # of syllables = 2.15	*Average # of syllables = 2.05*
Median Frequency = 32.5[7]	*Median Frequency = 22*

*First 16 words only used for GNAT

[7] Frequency is based on count per million spoken words according to http://memory.psych.upenn.edu/files/wordpools/kfpool.txt

Appendix E

Sample Pictures for All Animal Categories

Spider[a,b,c]

Butterfly[b,c]

Beetle[b]

Dragonfly[b]

Rabbit[a]

Snake[a]

Bear[a]

Zebra[a]

Crocodile[a]

Note: Superscript letter indicates task for which picture category was used. a = GNAT; b = VST; c = NSAT